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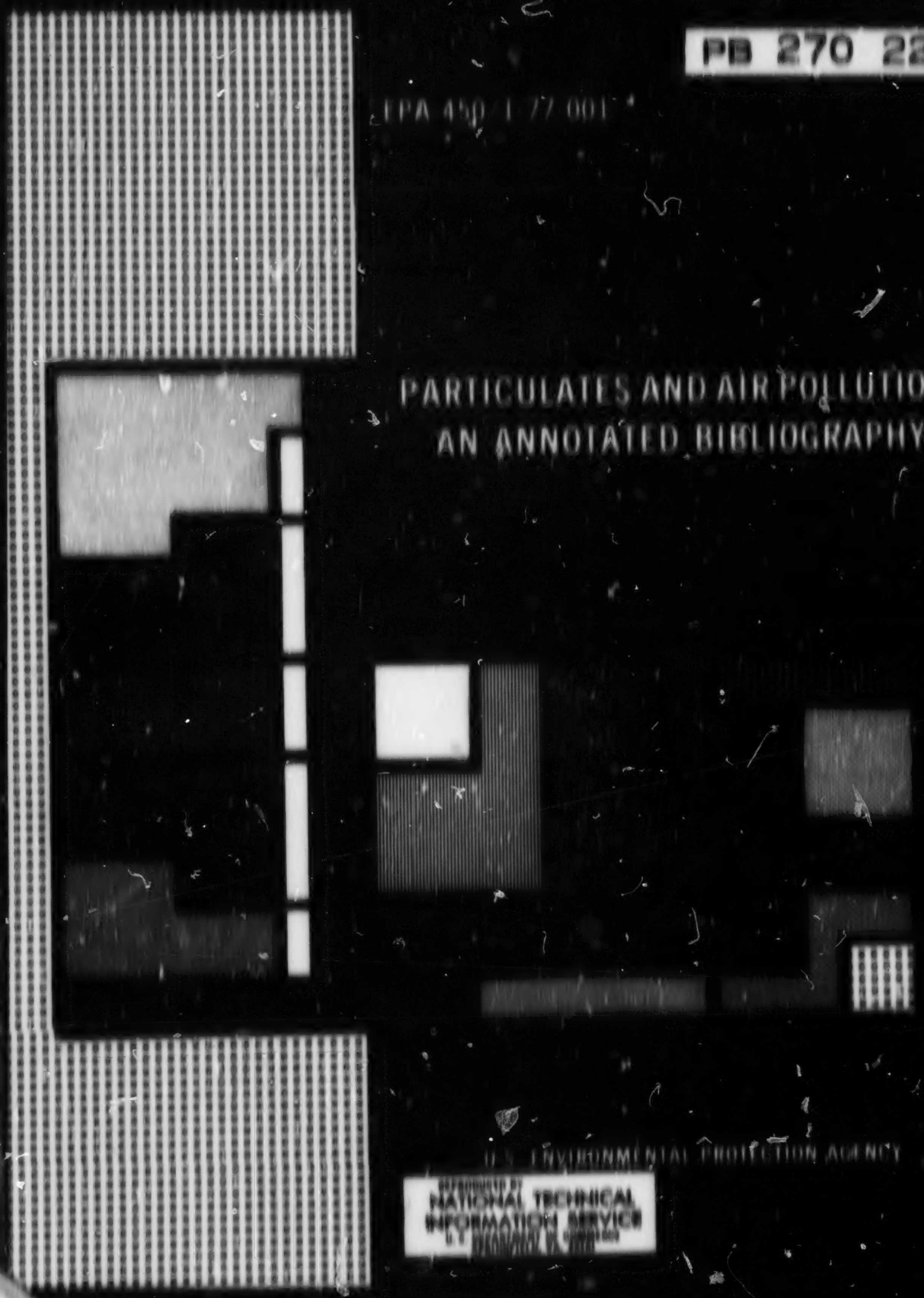

PARTICULATES AND AIR POLLUTION AN ANNOTATED BIBLIOGRAPHY

U.S. ENVIRONMENTAL PROTECTION AGENCY

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EPA's Office of Air Quality Planning and Standards has prepared, selected and compiled the 400 abstracts in this bibliography. The abstracts are arranged within 10 general subject categories. The abstracted documents are thought to be representative of available literature. Subject and author indices are included. The indices refer to the abstracts by a category code and abstract number. The author index lists all authors individually. Generally, higher abstract numbers have been assigned to more recent documents.

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PARTICULATES AND AIR POLLUTION: AN ANNOTATED BIBLIOGRAPHY

ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

April 1977

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PARTICULATES AND AIR POLLUTION: AN ANNOTATED BIBLIOGRAPHY

INTRODUCTION

Sources and conditions that produce particulates and the evaluation of the role of particulate matter in air pollution are among the most pressing concerns in pollution control efforts throughout the United States. To help in approaching these concerns, the Office of Air Quality Planning and Standards has compiled and produced this annotated bibliography.

The 400 abstracts in this volume have been selected from Environmental Protection Agency technical information storage and retrieval systems, professional publications, convention proceedings and special studies by public and private agencies and experts. These abstracts are arranged within the categories listed in the Contents Table. Subject and author indices refer to the abstracts by category letter and accession number. Generally, a higher accession number indicates a more recent document. The author index lists authors individually, and primary authorship is indicated by an asterisk.

All documents in this bibliography are currently on file at the Library of the Environmental Research Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Copies of these documents are available from the Library may free of charge to EPA employees, and state and local air pollution control agencies may obtain copies in microfiche format at no charge. Other readers may seek documents from publishers or authors or, under the Freedom of Information Act, may obtain them from the Library for a modest fee.

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A. EMISSION SOURCES

37176

Ter Haar, G. L., D. L. Lenane, J. N. Hu, and M. Brandt

COMPOSITION, SIZE AND CONTROL OF AUTOMOTIVE EXHAUST PARTICULATES. J. Air Pollution Control Assoc., 22(1):39-46, Jan. 1972. 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., 1971, Paper 71-111.)

Several vehicles manufactured during 1966-1970, operated on a chassis dynamometer under Federal 7-mode cycle conditions, were tested to determine total particulate composition, size of exhausted lead particulates, and the effects of traps on total lead emitted. Cars varied widely in the amounts and composition of their particulate emissions. Cold-cycle operation gave 2-8 times more particulate than hot engine operation. Lead compounds represented less than 1/3 of the total particulates, the remainder being carbon compounds along with ammonium and nitrate ions and unknown materials. Exhausted lead varied with the condition of the exhaust system and ranged between 7 and 50% of the lead consumed by the engine. Fuel additives affected the amount of emitted particulates. Probe sampling techniques underestimated by a large factor the amount of particulates emitted by vehicles. Trapping systems offered potential for greatly reducing the emission of suspended total particulates. The size of lead particulates was determined using 30 1966-model cars with stabilized exhaust deposits. Under Federal Cycle conditions, 18% of the lead burned was emitted as fine and 11% as coarse particles. (Author abstract modified)

44651

Govan, Francis A., Louis A. Terracciano, and Jerome Romm

SOURCE TESTING OF UTILITY BOILERS FOR PARTICULATE AND GASEOUS EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-73.)

An emission test program was conducted with the cooperation of several commercial testing organizations to evaluate the best particulate control techniques available for installation on new or substantially modified steam-generating systems. A total of 10 steam generators were tested for particulate, sulfur dioxide, and nitrogen oxides emissions. Public Health Service and ASME particulate emissions tests were performed concurrently for seven of the units. The average particulate emissions for the six coal fired steam-electric units tested were 0.21 and 0.08 lb/mill Btu of heat input by the PHS and ASME test methods, respectively. The average particulate emissions for the two oil fired steam-electric units tested were 0.17 and 0.08 lb/mill Btu of heat input by the PHS and ASME test methods respectively. The average particulate emission for the 2 coal fired industrial boilers tested were 0.11 and 0.08 lb/mill Btu of heat input for the PHS and ASME methods, respectively. A presurvey for the purposes of establishing liaison, setting operating parameters, outlining scaffolding requirements, checking sampling port conditions, and location of a clean-up area are a mandatory requisite for a valid test program. Recommended testing procedures are discussed.

44916

Leaderer, Brian P. and Gregory H. Sovas

ALLOCATION AND PROJECTION OF RESIDENTIAL AND COMMERCIAL EMISSIONS THROUGH USE OF THE LUNR INVENTORY. Preprint, Air Pollution Control Association, Pittsburgh, Pa., 23p., 1972. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-87.)

A technique was developed to estimate air pollution emissions from present and projected residential and commercial land uses by employing the Land Use Natural Resource Inventory (LUNR Inventory) in combination with population and commercial employee figures. While the method used for estimating total residential and commercial emissions is a well established one, the allocation of these emissions on a land use grid basis has a number of desirable advantages. The procedure allows for easy and accurate estimates of area source inputs for diffusion models, the projection of emissions resulting from future residential and commercial land development for any area in the state, the consideration of air pollutant emissions in land use-zoning procedures, and the testing of varying inputs to the system (i.e., population densities, fuel distributions) to determine the resultant emissions from future residential and commercial land use patterns and fuel policies in New York State. (Author abstract modified)

47139

Friedlander, S. K.

CHEMICAL ELEMENT BALANCES AND THE IDENTIFICATION OF AIR POLLUTION SOURCES. Preprint, California Inst. of Tech., Pasadena, 20p., 1971. 16 refs. (Presented at the Conference on Science in the Control of Smog, Pasadena, Calif., Nov. 15-16, 1971.)

Air pollution sources of given types, whether natural or man-made, emit a characteristic set of chemical elements in approximately fixed proportions. If the sources in a polluted region are known, the contributions from each source can be estimated by measuring elemental concentrations at a given point and solving a set of simultaneous linear algebraic equations. The method was applied to particulate matter measured in the air of Pasadena over an 11-hour period and averaged over particle size. For the test period, about 15% of the particulate matter resulted from primary natural sources and 35% from primary man-made sources. Sources included sea salt, soil dust, automobile exhaust fuel oil fly ash, Portland cement, and tire dust. About 1/3 of the total resulted from atmospheric reactions with 1/4 produced by the conversion of gas phase hydrocarbons to particulate form. The estimate for this figure is based on a carbon balance. About 70% of the total particulate burden was accounted for, with water probably making up a significant portion of the missing 30%. Improvements and extensions of the method are discussed. (Author abstract modified)

[illegible]

Jones, James R.

AIR POLLUTION FROM MINING OPERATIONS. Preprint, American Inst. of Mining, Metallurgical and Petroleum Engineers, New York, Society of Mining Engineers, 13p., 1973. 1 ref. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, 102nd, Chicago, Ill., Feb. 26-March 1, 1973, Paper [illegible].)

The potential sources of emission discussed in this paper cover only the major problems facing the coal industry. The modern coal mining industry is aware of the many rules and regulations facing it with regard to the environment. All sources of potential air pollution emissions at existing, as well as new coal mine operations must undergo careful scrutiny. The most obvious and expensive control will be that of particulate emissions from thermal driers. These are capable of measurement of stack emission tests. Fugitive dust emissions from breakers, crushers, and other preparation plant facilities emitting dust will require water sprays or enclosures with some type of collector. Handling systems as well as loading facilities will require efforts to minimize fugitive dust. Haulage roads will require oiling and more frequent spraying with water to allay dust. This will be particularly true in areas visible from public roads and neighboring residences. (Author summary modified)

34010

Feldman, P. L. and D. W. Coy

COMPARISON OF COMPUTED AND MEASURED OPACITIES: LIGNITE-FIRED BOILERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 32p., 1973. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-168.)

The correlation between plume opacity and particle size distribution and mass concentration was studied. Emission and opacity measurements were obtained using two lignite fired boilers. A Brink cascade impactor was used to collect size distribution data, and two type sampling trains were used to measure particulate concentrations. A computer program was developed to predict opacity given the size distribution and mass concentration data. The predicted opacities were then compared with the measured values. The program was written so that it was not necessary to approximate the distribution by a single log-normal distribution. Extinction efficiency factors were calculated from the Mie equations using a subroutine developed by IBM. Opacities were calculated from the Lambert-Beer Law with extinction coefficients evaluated by numerical integration over the size distribution data. Special care should be taken in the measurement of mass concentration and size distribution data which are to be used to calculate opacities. Significant error in computed opacity can result from normal error in these measurements. Further, opacity in itself has little value as a general indicator of particulate mass concentration or particle size. Thus, each system under study must be described in detail before opacity has practical meaning. For nonabsorbing particles, the size range encompassing 0.1 to 1 micron radii is generally the most important in determining the overall opacity. Therefore, for acceptable correlation of opacity and particle size and mass data, the size distribution data in this range must be accurately represented. It is not sufficient, in many cases, to represent the data as a single log-normal distribution. (Author abstract modified)

34083

White, Richard K. and John R. Ogilvie

DEVELOPMENTS IN THE CONTROL OF AIR POLLUTION PROBLEMS ASSOCIATED WITH LIVESTOCK PRODUCTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1973. 33 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-164.)

The status of research and technology for evaluating and controlling air pollution problems associated with livestock production units is reviewed. The major problems are dust from cattle feed lot and from confined poultry and swine buildings, high levels of gases within confined livestock housing, and odor problems associated with the handling, treatment and disposal of livestock manures. The principal areas of future research needs are correlating quantitative analytical data with sensory evaluation under field conditions and the development of a dispersion model for odors. (Author summary modified)

34087

Hagen, L. J. and N. P. Woodruff

PARTICULATE LOADS CAUSED BY WIND EROSION IN THE GREAT PLAINS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1973. 11 refs. (Presented at Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-162.)

Previous research related dust concentrations to visibility and showed that the median dust storm concentration was 4.81 mg/cu m and the average duration was 6.6 hr. Wind speed and particulate concentration profiles were integrated to compute dust passage at various locations in the Great Plains. The annual dust passage varied widely, depending upon precipitation, but it averaged 40,000 tons per vertical sq mile in the 1950's and 12,000 tons in the 1960's. Changes in the dust passage between adjacent locations were consistent, and the lowest dust passage occurred in the least erosive areas. The estimated total particulates suspended in dust storms ranged from 17 to 551 million tons annually; the average dropped from 244 million tons in the 1950's to 77 million tons in the 1960's. Estimates of suspended particulates agreed well with dust deposition data collected for a limited period in the 1960's. Based on these estimates, wind erosion produces a larger mass of particulates than do all other primary sources in the United States combined. Further, the high concentrations and frequent occurrence of dust storms make it doubtful that any Great Plains state can meet all the criteria in the National Ambient Air Quality Standards, particularly if particle size continues to be disregarded in the standards. (Author abstract modified)

34138

Sehmel, George A.

INFLUENCE OF SOIL EROSION ON THE AIRBORNE PARTICLE SIZE DISTRIBUTION FUNCTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1973. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-163.)

Airborne particle size distributions were determined, and adequate particle sampling techniques over a semiarid region were established. The airborne particle size distribution function was determined for particle diameters from 1 to 230 microns at 6 heights from 0.3 to 30 m. The airborne particles in the respirable size range were determined using cascade particle impactors and the larger particles were collected by deposition within a wind direction self-orienting attachment to the impactors. The lower limit of the distribution function was represented by delta N/delta D equals alpha D to the beta power, in which D is the particle diameter and beta is an experimentally evaluated exponent. The distribution function decreased up to 10 orders of magnitude as the particle diameter was increased from 1 to 240 micron. On windy, dusty days, for the 240 micron particles, the distribution function increased to five orders of magnitude. The distribution function for 1 micron particles increased at most one order of magnitude. On nondusty, nonwindy days, there is an apparent lower limit to the distribution function. The exponential decrease in the size distribution is proportional to D to the -1.69 for particle diameters, D, between 1 and 40 micron and the decrease is proportional to D to the -3.48 power. The distribution function for smaller particles was determined using hi-volume cascade impactors. Particles were collected on the internal surfaces of the cascade impactors at locations other than on the engineered particle impaction sites. This undesired collection is termed a wall loss. The fractional wall losses were a function of either sampling time (spring vs. late summer) or sampling duration (40 hr versus less at 300 hr). (Author abstract modified)

54121

Heisler, S. L., S. K. Friedlander, and R. B. Husar

THE RELATIONSHIP OF SMOG AEROSOL SIZE AND CHEMICAL ELEMENT DISTRIBUTIONS TO SOURCE CHARACTERISTICS. Atmos. Environ. 7(6):633-649, June 1973. 29 refs.

A method for calculating the number and chemical element size distribution of Pasadena aerosols in a polluted atmosphere was developed based on measured source characteristics and a chemical element balance for collected aerosol samples. Secondary formation processes for particulate matter significantly modify the primary source spectrum and are taken into account using certain models for the conversion processes. The calculated size and volume distributions compare well with experimental data. Calculations of the chemical element distribution with respect to size have also been made. A simplified model was adopted for sulfur oxide conversion. All the chloride in the micron aerosol component was replaced on a molar equivalent basis by sulfate and the resulting droplets assumed to be saturated. The volume of the supersaturated droplet remains close to the saturation value. The replacement of chloride accounted for 0.038 micrograms m of sulfate and 0.008 micrograms m of water were associated with the saturated droplets. Organics are also a secondary source. (Author abstract modified)

54614

McGarry, Frederick J. and Constantine J. Gregory

A COMPARISON OF THE SIZE DISTRIBUTION OF PARTICULATES EMITTED FROM AIR, MECHANICAL, AND STEAM ATOMIZED OIL-FIRED BURNERS. J. Air Pollution Control Assoc., 22(8):636-639, Aug. 1972. 5 refs.

Particulate air samples were collected from the effluent gases from three steam generating boilers at an electric generating station. Samples were collected by an Andersen Stack Sampler which operates on the principle of a cascade impactor. The samples were separated into eight size ranges and were deposited on the collection plates of the sampler. These plates were weighed with the samples and compared with their tare weights to obtain the weight per plate and the total weight of particulates collected. The percent of the total weights retained on each plate was then computed for each sampling date. The plumes produced by each type of fuel atomizer were observed and compared to the results of the particulate samples. The air atomized burner produced the greatest percentage of particulates by weight in the submicron range of the three types of atomizers investigated. The air atomized unit also produced particulates with a lower combustible content than either of the other two units. The mechanical atomized burner produced particulates which were concentrated in the 9.2-3.3 micron range. The steam atomized burner produced a particulate distribution which was spread approximately through the particulate size ranges investigated. (Author summary)

57524

Lee, Robert E., Jr., Howard L. Crist, Allen E. Riley, and Kathryn E. MacLeod

THE CONCENTRATION AND SIZE OF TRACE METAL EMISSIONS FROM A POWER PLANT, A STEEL PLANT, AND A COTTON GIN. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., National Environmental Research Center, 23p., 1973. 18 refs.

An in-stack cascade impactor was used to determine the size distribution of particles, before and after emission control systems, of a coal-fired power plant, a steel plant, and a cotton gin. Samples were analyzed for total particulate matter and elemental metal content by graphite-furnace atomic absorption; selenium was analyzed by neutron activation. A sharp decrease in the concentration and particle size was observed after the particulates passed through the control systems. Pronounced metal concentration and particle size relationships were found in the power plant and steel plant samples. The power plant outlet samples showed a concentration of chromium, lead, antimony, zinc, and selenium in the particle size range of 0.1 micron in diameter. The baghouse control system on the steel plant was extremely efficient in removing metal-containing particles below 5 micron in diameter. Mass and particle size distribution were correlated for particulates collected before and after an electrostatic precipitator at a coal-fired power plant, before and after a baghouse at an electric arc furnace steel plant, and before and after a wet scrubber at a cotton gin. Potential sources of error in the study were associated with the accuracy of the sampling method, and included wall loss effects, particle reentrainment, and calibration inaccuracies. (Author abstract modified)

60240

Ganley, John T. and George S. Springer

PHYSICAL AND CHEMICAL CHARACTERISTICS OF PARTICULATES IN SPARK IGNITION ENGINE EXHAUST. Environ. Sci. Technol., 8(4):340-347, April 1974. 27 refs.

The formation and emission of particulates in the exhaust gas of a 350 cu in Chevrolet V-8 spark ignition engine mounted on a dynamometer and operated at constant speed and load were investigated. Both leaded (Indolene HO 30) and unleaded (Indolene HO 0) fuels were used, and the weight concentration and size distribution of the particles were measured over a wide range of exhaust gas temperatures (90-830 F). A large increase in weight concentration as the exhaust gas temperature decreased from 430-470 F was observed with the leaded fuel and was attributed to the condensation of lead salt vapors in the exhaust system; the weight concentration was constant at all exhaust temperatures above 250 F for the unleaded fuel. The size distributions lay within a relatively narrow band for the unleaded fuel, and no discernible trend with respect to temperature was observed; several size distributions were noted for the leaded fuel, and the size distribution was a strong function of exhaust gas temperature. The shape of the particulates, the effect of engine speed, load, and air fuel ratio on particulate weight concentration and size distribution, the effect of spark timing on particulate weight concentrations, and the chemical composition of the particulate matter were also examined.

60301

Craig, Alfred B.

OVERVIEW OF THE FINE PARTICULATE PROBLEM. Preprint, Joint U. S.-U.S.S.R. Working Group on Stationary Source Air Pollution Control Technology, 13p., 1974. (Presented at the Symposium on Control of Fine Particulate Emissions from Industrial Sources, Jan. 15-18, 1974.)

The problem of fine particulate emissions is reviewed in terms of air quality and new source performance standards, measurement techniques, major industrial sources, available control methods, and human health effects. Inertial impactors are currently being used by the Environmental Protection Agency to give reproducible particle size distribution and mass fractional efficiency data down to about 0.1 micron, and the Southern Research Institute under EPA sponsorship is using a series of diffusion batteries coupled with condensation nuclei counters to provide concentration and size distributions by number over the size range from about 0.01-0.3 micron. Particulate sulfate, the most abundant secondary fine particulate, appears to have a threshold health effect level about one order of magnitude lower than total suspended particulate, and the only obvious control strategy is precursor control (sulfur dioxide and catalyst materials). Locus of particulate deposition and time of retention in the respiratory system are both dependent on particle size; fine particles are retained for much longer periods of time. Probably the most efficient fine particulate control device tested by EPA to date is a high pressure steam scrubber developed by the Lone Star Steel Company; greater than 99% of all particulate can be removed down to 0.05 micron.

63181

Kaakinen, John W., Roger M. Jorden, and Ronald E. West

TRACE ELEMENT STUDY IN A PULVERIZED-COAL-FIRED POWER PLANT. Preprint, Air Pollution Control Assoc., 33p., 1974. 24 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-8.)

Trace element concentrations and total mass flow rates of solid and liquid materials in all inlet and outlet streams of a pulverized-coal-fired power plant were measured to study the fate of trace elements from coal combustion. Concentrations of 17 elements were determined by atomic absorption spectrophotometry, X-ray fluorescence spectroscopy, and wet chemistry. Overall mass balances for nine elements gave closures within 10%. Aluminum, iron, rubidium, strontium, yttrium, and niobium were at essentially constant concentrations in all outlet ash streams. Copper, zinc, arsenic, molybdenum, antimony, lead, and the radioisotopes lead-210 and polonium-210 were in their lowest concentrations in the bottom ash and in progressively higher concentrations in fly ash collected successively downstream toward the stack. The bulk of the coal influx of elements in both of these groups were retained in ashes at the power plant. Poor mass balance closures for mercury and selenium based only on solid and liquid samples suggested that portions of these two elements existed as vapors and/or very fine aerosols in flue gas which passed through the particulate control devices. The successive enrichment in the downstream direction of certain trace elements in fly ash was probably due to volatilization of these elements or their compounds in the furnace, their subsequent condensation or adsorption onto suspended fly ash particles, resulting in their relatively higher concentrations in the finer particles, and the relatively greater penetration of these finer particles through the particulate control devices. (Author abstract)

63184

Walker, A. B.

CHARACTERISTICS AND ELECTROSTATIC COLLECTION OF PARTICULATE EMISSIONS FROM COMBUSTION OF LOW SULFUR WESTERN COALS. Preprint, Air Pollution Control Assoc., 24p., 1974. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-11.)

About 80% of the known strippable low-sulfur coal reserves in the U. S. are in the area west of the Mississippi River. These coals can meet sulfur oxide emission regulations without the need for flue gas desulfurization. The principal use of these coals will be as fuel for conventional boilers which will require particulate removal efficiencies in excess of 99%. The emission characteristics and electrostatic precipitator performance tests on these coals are described. Mass emissions as a percentage of fuel ash were somewhat lower than Eastern bituminous coals, but there was insufficient information to suggest deviation from currently available methods, based upon Eastern coals, for predicting ash carryover. Size distribution of particulate emissions on pulverized coal units was similar to that of Eastern bituminous coal. However, size distribution of particulates from Western coals in cyclone boilers was somewhat coarser than from the same fuel in pulverized coal units or predicted from available data on Eastern bituminous coals burned in cyclone boilers. Bulk electrical resistivity of Western fuel ash at typical air heater outlet temperatures varied over a wide range, could not be predicted on the basis of fuel sulfur alone, and generally was above the level where back corona would be expected. The bulk electrical resistivity of Western fuel ash, at typical air heater inlet temperatures, varied over a narrower range with most of the cases encountered being below the level where back corona would be expected. Precipitator performance can generally be correlated according to a modified form of the Deutsch equation. This indicates that specific collecting electrode areas in the range of 150-550 sq ft/1000 acfm are required for achievement of 99% on fly ash with in-situ resistivity levels in the range of 10 to the 10th to 10 to the 13th power ohm-cm; and that specific collecting areas as high as 900-1000 sq ft/1000 acfm may be required to achieve efficiencies in the 99.8% range. (Author abstract modified)

63207

Roberts, John W., Harry A. Watters, Carl A. Mangold, and August T. Rossano

COST AND BENEFITS OF ROAD DUST CONTROL IN SEATTLE'S INDUSTRIAL VALLEY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1974. 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-86.)

In a study done in Seattle's Duwamish Valley, the impact of road dust on air quality was measured by obtaining dust emission factors for vehicles traveling at 10, 20, and 30 mph on gravel as well as dusty paved roads. The paving of gravel roads with an average daily traffic (ADT) over 15 is a least-cost method for reducing suspended particulates in the air in Seattle. A Mark II Cascade Impactor was mounted on a trailer and towed behind a car to determine the concentration and size distribution of this dust. Each vehicle at 30 mph on unpaved roads contributed 7.0 lb of dust to the air, 1.8 lb consisting of particles smaller than 10 micron in diameter and 0.34 lb below 1 micron. Three to 8% by weight of this respirable dust was free silica, which is potentially toxic. The quantity of dust generated varies as an exponent of the speed. The concentrations of dust found in the air near a dry gravel road with an ADT of 250 reached 584 micrograms/cu m for an 8-hr work day. A 24-hour suspended particulate reading of 463 micrograms/cu m and 7.83 micrograms/cu m free silica was found beside a dusty paved road with an ADT of 18,000. Nineteen miles of gravel roads and 110 mi of dusty paved roads contributed 2,700 tons/yr of particulates, of which 700 tons were below 10 micron. The cleaning and paving of roads will produce benefits of $3,481,000 yearly in reduced cleaning, health care, sewer, vehicle operation, and road maintenance as well as an increase in property values. Clean roads can lower the cost of clean air in Seattle.

06847

Amick, Robert S., Kenneth Axetell, Jr., and Dale M. Wells

FUGITIVE DUST EMISSION INVENTORY TECHNIQUES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1974. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-98.)

The Clean Air Act of 1970 required all states to submit statewide emission inventories as an integral part of their implementation plans. As a result, emission inventory techniques for conventional area sources and point sources were well developed. Fugitive dust sources were not generally included in these inventories, although they are prevalent in the Great Plains, Far West, and Southwest, where arid conditions on flat, exposed topography, coupled with relatively high wind speeds, create several sources of particulate emissions. The major fugitive dust sources are unpaved roads, agriculture, land development, construction, quarrying, mining, tailings, aggregate storage, and cattle feedlots. A method is presented for determining fugitive dust particulate emission inventories for a specific, long-term inventory as well as for a more general, short-term survey. The complete fugitive dust emission inventory includes a definition of the area to be surveyed, identification of the significant sources, quantification by source category, and summation of the significant source categories emissions to obtain the total fugitive dust contribution. Emission factors are given for the various fugitive dust sources, and the data for the Colorado fugitive dust emission inventory are given.

07814

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PRIMARY ALUMINUM INDUSTRY. VOLUME 2, TEST DATA SUMMARY (FINAL REPORT). Rept. EPA-450/2-74-020b, 51p., Oct. 1974. 17 refs. NTIS: PB 237[illegible]/AS

A summary is presented of source tests and visible emission measurements which were cited in Technical Report: An Investigation of the Best Systems of Emission Reduction for the Primary Aluminum Industry. The summary is concerned principally with tests for fluorides and visible emissions but also describes the facilities, their operating conditions, and characteristics of exhaust gas streams. Average primary outlet emissions (fluorides) for 11 primary aluminum facilities tested were: 0.0123, 0.016, 0.26, 0.405, 0.50, 0.130, 0.446, 0.51, 0.06, 0.74, and 0.11 lb/ton of product. Roof emissions (fluorides), secondary outlet fluorides, and visible emissions are also tabulated. Many of the tests were conducted using the Environmental Protection Agency Method 13 which will be proposed in the Federal Register at the time of proposal of the performance standards for new or substantially modified primary aluminum plants.

07903

Dannis, M. L.

RUBBER DUST FROM THE NORMAL WEAR OF TIRES. Rubber Chem. Technol., 47(4):1011-1037, Sept. 1974. 38 refs.

Results from studies on the nature of tire debris are presented. Particles worn from tires were collected on sticky panels mounted under vehicles and appeared to approach cylinders or sausage shapes. The particles ranged from about 0.1 mm, equivalent diameter, to a few microns minimum, in accord with the Schallamach description of tire abrasion. Particles caught on the filter plates of an isokinetic filter system were examined, transferred to microscope slides, photographed, and counted to obtain particle size distributions. Smooth distributions were obtained, with the geometric mean particle size being about 20 micron equivalent diameter. Very few particles in the range of 0.3-1 micron were found. Attempts to identify volatile emissions using gas chromatography were unsuccessful; and, since hydrocarbon loss as a vapor from tires was nil, particulate erosion appeared to be the dominant loss mechanism. Tire dust particles were subject to oxidation, with biochemical oxidation at the soil surface under the combined influence of oxygen, photooxidation, and enzyme catalysis being rapid.

08018

Davison, Richard L., David F. S. Natusch, John R. Wallace, and Charles A. Evans, Jr.

TRACE ELEMENTS IN FLY ASH: DEPENDENCE OF CONCENTRATION ON PARTICLE SIZE. Environ. Sci. Technol., 8(13):1107-1113, Dec. 1974. 33 refs.

The concentrations of 25 elements in fly ash emitted from a coal fired power plant were measured as function of particle size. Analytical techniques included spark source mass spectroscopy, optical emission spectrography, atomic absorption spectroscopy, and X-ray fluorescence spectroscopy. The highest concentrations of the elements were in particles which deposit in the pulmonary region of the respiratory system. Existing particle control devices are least effective for removing the most toxic particles. The concentrations of lead, thallium, antimony, cadmium, selenium, arsenic, zinc, nickel, chromium, and sulfur increased markedly with decreasing particle size. A mechanism involving high temperature volatilization of a species containing the trace element followed by preferential condensation or adsorption onto the smallest particles is proposed to account for the trace element concentration dependence on particle size. The environmental significance of the results is discussed including their relation to urban aerosols. (Author abstract modified)

08021

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: PRIMARY ALUMINUM INDUSTRY. VOLUME 1: PROPOSED STANDARDS. Rept. EPA-450/2-74-020a, 133p., Oct. 1974. 13 refs. NTIS: PB 237[illegible]/AS

The proposed standards of performance for primary aluminum plants and the rationale for the degree of control selected are described. Analytical methods for sampling emissions and the environmental and economic impact of the standards are discussed. During initial plant surveys, source measurements, and a later visit to Norway, seven primary aluminum reduction plants were observed to have visible emissions of about 10% opacity or less; four with dry control systems had no visible emissions. One domestic carbon anode bake plant had visible emissions of less than 20% opacity, another domestic plant had 10%. The Norwegian anode bake plant had about 10%. The primary standard was based on primary emissions, which averaged less than 0.1 lb TF/TAP (total fluoride/ton of aluminum produced) which were achieved on four plants; one foreign plant reported primary emissions of less than 0.1 lb TF/TAP. Three of the six tests of secondary systems showed average emissions of less than 1.0 TF/TAP, including two plants with elaborate sampling and flow measurement devices. Based on an assumed fluoride control efficiency of only 95%, emissions from carbon bake plants can be controlled to below 0.05 lb TF/TCAP. Data were obtained from plants in which the collection systems were upgraded and control systems retrofitted to an existing plant. New plants should easily be able to achieve the recommended standard of performance. The economic impact upon the domestic primary aluminum industry of the standards is not considered to be adverse. The economic impact would be adverse if more stringent standards were to be imposed upon the industry. The proposed standard of 2.0 lb/TF/TAP is supported by measurement of emissions from potrooms. Control technology for anode bake plants is available to achieve 0.05 lb TF/TCAP. The standard will require installation and proper maintenance of equipment representative of the best technology which has been demonstrated for the industry. (Author summary modified)

60911

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: ELECTRIC SUBMERGED ARC FURNACES FOR PRODUCTION OF FERROALLOYS. VOLUME 2: TEST DATA SUMMARY. Rept. EPA-450/2-74-018b, 84p., Oct. 1974. 31 refs. NTIS: PB [illegible]/AS

Test results and visible emission measurements on electric submerged arc furnaces for production of ferroalloys are described. The background information and rationale used in the development of proposed standards of performance and the economic and environmental impacts of the standards are discussed. The operating conditions of the tested facilities, characteristics of the exhaust gas streams, deviations from prescribed test procedures, and results of particulate matter and carbon monoxide tests are presented. Results are given of tests of electric submerged arc furnaces producing ferromanganese equipped with various types of control methods including venturi and centrifugal scrubbers, settling chambers, baghouses, fume hoods, electrostatic precipitators, and flares.

60913

Statnick, Robert M.

MEASUREMENT OF SULFUR DIOXIDE, PARTICULATE, AND TRACE ELEMENTS IN COPPER SMELTER CONVERTER AND ROASTER/REVERBERATORY GAS STREAMS (FINAL REPORT). Environmental Protection Agency, Research Triangle Park, N. C., Control Systems Lab., ROAP 21ADM-013, Program Element 1AB013, Rept. EPA-650/2-74-111, 93p., Oct. 1974. 33 refs.

The results of the analysis of data on particulate, sulfur dioxide, and trace element emissions and control efficiencies for a copper smelter are given. The SO2 emission rates from the roaster/reverberatory and converter effluent streams were 518 and 187 lbs/min, respectively. The acid plant's SO2 control efficiency was 98.9%. The mass collection efficiency of the converter's electrostatic precipitator for dry filterable solids was 99%. The electrostatic precipitator had a minimum collection efficiency for dry filterable solids of 0.1-1.0 micron. Analyzing emitted particulate gave the following mass emission rates (in lbs/hr) for selected elements: arsenic (38.09), lead (34.61), cadmium (1.33), zinc (13.7), chromium (0.061), and copper (4.03). Control efficiency for the analyzed elements was between 90 and 99%. An appendix presents methods for sampling and analysis of mercury vapor in industrial streams containing SO2. (Author abstract modified)

60914

Chu, Richard B.

NONSTACK GAS PARTICULATE EMISSIONS FROM CHEMICAL AND POWER PLANTS - A REVIEW. Preprint, American Inst. of Chemical Engineers, 13p., 1974. 16 refs. (Presented at the American Institute of Chemical Engineers, Annual Meeting, 67th, Washington, D. C., Dec. 5, 1974, Paper 80c.)

Major fugitive dust and nonstack particulate emission sources in power and chemical plants are described. The dispersion, distribution, and physico-chemical properties of these airborne particulate matters are also mentioned. Fugitive dust and particulate matter from the following sources were studied: cooling tower drift, coal storage, fly ash handling, construction and unpaved roads, and limestone processing. Their formation and control measures are described. Plant facility damages and environmental effects caused by airborne particles are also reviewed including atmospheric contamination of electric transmission insulators causing electric flashover, atmospheric corrosion, and environmental effects such as fogging and icing on roads. The major control methods for the sources are: advanced drift eliminators and high blowdown for cooling towers; water sprays, water/chemical sprays, asphalt coverings, tar coverings, clay coverings, and vacuum dust removal systems for coal storage and handling; paving, speed limits, watering by trucks for unpaved roads; watering by trucks or sprinkling systems, chemical soil stabilization, and planting of vegetation for construction; water sprays and filter and vacuum collecting systems for limestone handling; and water wetting and washing down the loading area for fly ash handling.

60919

Cowherd, Chatten, Jr., Kenneth Axetell, Jr., Christine M. Guenther, and George A. Jutze

DEVELOPMENT OF EMISSION FACTORS FOR FUGITIVE DUST SOURCES (FINAL REPORT). Research Inst., Kansas City, Mo., Office of Air and Waste Management Contract 68-02-0619, Rept. EPA-450/3-74-037, 181p., June 1974. 38 refs. NTIS: PB [illegible]/AS

Field tests were conducted to develop emission factors for the following common sources of fugitive dust: unpaved roads, agricultural tilling, aggregate storage operations, and heavy construction activities. For each source type, emissions were related to meteorological and source parameters, including properties of the emitting surface and characteristics of the vehicle or implement which caused the emission. The information was used to derive correction factors which appropriately adjust basic emission factors to reflect regional differences in climate and surface properties. Calculated emission factors for unpaved roads ranged from 6.0 to 53.9 lb/vehicle-mi. Average dust emissions from unpaved roads had the following particle size characteristics: less than 2 micron, 25 wt%; 2-30 micron, 11 wt%; and 30-100 micron, 43 wt%. Emission factors for agricultural tilling ranged from 31.6-87.3 lbs/acre, with particle size characteristics of 11 wt% for particle diameters less than 2 micron, 43 wt% for 2-30 micron, and 40 wt% for particle diameters over 30 micron. Emission factors for aggregate storage emissions (total storage cycle) were: 0.04 lbs/ton for loading onto piles, 0.13 lbs/ton for vehicular traffic, 0.11 lbs/ton for wind erosion, and 0.05 lbs/ton for loadout from piles. Estimated emission values from two construction sites were 1.4 and 1.0 tons/acre/mo.

69976

Cowherd, Chatten C., Jr., Christine M. Guenther, and Dennis D. Wallace

EMISSIONS INVENTORY OF AGRICULTURAL TILLING, UNPAVED ROADS AND AIRSTRIPS, AND CONSTRUCTION SITES (FINAL REPORT). Midwest Research Inst., Kansas City, Mo., Environmental Protection Agency Contract 68-02-1437, Rept. EPA-450/3-74-085, 49p., Nov. 1974. 21 refs. NTIS: PB 238919/AS

A national emission inventory was developed on a county-by-county basis to determine the air pollution impact of selected fugitive dust sources. Source categories included were unpaved roads, unpaved airstrips, heavy construction sites, and agricultural land tilling. Emission factors, which include correction factors to adjust for local climatic conditions and properties of emitting surfaces, were calculated for each county. Measures of the extent of activity for each category were derived from available data. The methodology including procedures used to estimate missing data is documented. The source data were coded on the National Emission Data System area source forms. (Author abstract modified)

71409

Pierson, W. R. and Wanda W. Brachaczek

AIRBORNE PARTICULATE DEBRIS FROM RUBBER TIRES. Rubber Chem. Technol., 47(5):1275-1299, Dec. 1974. 54 refs. (Presented at a joint meeting of the Rubber Division of the Chemical Institute of Canada, Toronto, May 7-10, 1974.)

Road tests in tunnels and in the open air were conducted to determine the amount of airborne particulate debris generated from rubber tires. Airborne particulates accounted for a small fraction of the total tire wear, with most of material worn from tires being in the form of nonsuspendable particulates deposited near the road. Tire debris comprised about 1-4% of the total airborne particulate matter generated by road vehicles of all categories in tunnels. Depending on driving conditions, the amount of airborne tire particulate matter ranged from 5-45% (20% average) of that emitted from the exhausts of gasoline engines burning leaded fuel. The concentration of airborne tire particulate matter in urban areas appears to be about 1 microgram/cu m or 1% of the total particulate loading. The nationwide production of airborne tire particulates (about 30,000 tons/yr) does not appear to justify the consideration of tire wear as a major source of pollution. (Author conclusions modified)

72401

Schulz, E. J., R. B. Engdahl, and T. T. Frankenberg

SUBMICRON PARTICLES FROM A PULVERIZED COAL FIRED BOILER. Atmos. Environ., 9(1):111-119, Jan. 1975. 5 refs.

The size distributions of submicron particles at the inlet and outlet of an electrostatic precipitator serving a coal-fired thermal power plant were measured with a Battelle number 6 cascade impactor and an in-stack Andersen sampler. Scanning electron microscope photographs indicated that most of the particles were spherical with the mean sizes at the precipitator inlet and outlet being 5 and 2.25 micron, respectively. About 50% of the weight of the particles leaving the precipitator appeared to be less than about 2 micron and about 15% were less than 1 micron in size. The majority of the 1.0 micron particles appeared to be condensed materials. (Author abstract modified)

72045

Van Loon, M. and Larry Resnick

IMPACT OF EMISSIONS FROM FARM EQUIPMENT AND OFF-ROAD HEAVY DUTY EQUIPMENT ON AIR POLLUTION IN CALIFORNIA. Preprint, Society of Automotive Engineers, Inc., New York, 13p., 1973. 14 refs. (Presented at the Society of Automotive Engineers National Combined Farm, Construction and Industrial Machinery and Fuels and Lubricants Meetings, Milwaukee, Wis., Sept. 10-13, 1973, Paper 730830.)

The impact of uncontrolled emissions from farm equipment and off-road heavy duty equipment using gasoline or diesel internal combustion engines is estimated for the state of California. Estimates of hydrocarbon, carbon monoxide, nitrogen oxide, sulfur oxide, and particulate emissions from diesel and gasoline operated off-road heavy duty equipment based on estimates of population, annual usage, horsepower, and emission factors are: 30.0, 448.0, 107.2, 13.8, and 12.4 tons/day. Similar estimates for farm equipment are: 29.9, 307.0, 86.4, 4.9, and 6.4 tons/day for hydrocarbons, CO, NOx, SOx, and particulates, respectively. While farm and off-road heavy-duty equipment do not constitute major emission contributors to California's air pollution problem, the emissions from these sources are nevertheless significant. Projected estimates of hydrocarbons and NOx emissions from such equipment for the years 1977 and 1980 indicate that these emissions will not be major factors in comparison to emissions from all sources in the state.

74251

Cardina, J. A.

PARTICLE SIZE DETERMINATION OF TIRE-TREAD RUBBER IN ATMOSPHERIC DUSTS. Rubber Chem. Technol., 47(4):1005-1010, Sept. 1974. 2 refs. (Presented at the American Chemical Society, Rubber Division and Chemical Institute of Canada, Macromolecular Science Division, Joint Meeting, Toronto, Ontario, May 7-10, 1974, Paper 53.)

Ambient dust within 20 ft of heavy traffic on an expressway was sampled and analyzed for tread rubber by pyrolysis gas chromatography. Dust particles of respirable size (1.1-7.0 micron) accounted for 37-40% of the total by weight, and the remainder of the particles were divided about equally between the size range above 7.0 micron and that below 1.1 micron. The amount of tread rubber in the respirable dusts averaged about 4.5%; that in dust over 7.0 micron in size averaged about 8.5%. The tread rubber content of particles in the respirable range averaged 3.8 micrograms/cu m of suspended particulates and was considered to be of low potential health hazard. (Author summary modified)

75141

Shannon, Larry J., P. G. Gorman, M. P. Schrag, and D. Wallace

EMISSIONS CONTROL IN THE GRAIN AND FEED INDUSTRY: VOLUME II - EMISSION INVENTORY (FINAL REPORT). Midwest Research Inst., Kansas City, Mo., Office of Air

and Waste Management Contract 68-02-0611, Rept. EPA-650/2-75-[illegible], [illegible]p., Sept. 1974. 4 refs. NTIS: PB [illegible]/AS

A particulate emissions inventory for the grain and feed industry is presented along with projected emissions for the years 1975 and 1980. Emission calculations are given for the latest year that production data are reported (generally 1969-1971). Current levels of control are calculated by assuming that cyclones are 85% efficient and fabric filters 99% efficient. The following assumptions are made concerning the future extent of control when projecting emissions to 1975 and 1980: a linear relationship exists between the present and future level of emissions; large operations located mainly in urban areas will reach 100% application of the most efficient control devices by 1980; smaller operations will reach 100% control by 1980 or 1985; and application of control at small operations in rural areas will increase at a fixed rate (e.g., 5%/yr).

77854

Ctvrtnicek, T. E., S. J. Rusek, and C. W. Sandy

EVALUATION OF LOW-SULFUR WESTERN COAL CHARACTERISTICS, UTILIZATION, AND COMBUSTION EXPERIENCE (FINAL REPORT). Monsanto Research Corp., Dayton, Ohio, Dayton Lab., Environmental Protection Agency Contract 68-02-1320, Program Element 1AB013, ROAP 21BBZ-005, Task 13, Rept. EPA-650/2-75-046, MRC-DA-467, 465p., May 1975. 104 refs. NTIS: PB 243911/AS

Detailed information and statistics on western coal resources, mining, production, composition, and combustion properties are presented. Over 40% of some 200 billion tons of demonstrated coal reserves in the western states is surface minable. Approximately 80% of sub-bituminous coal reserves and 91% of lignite reserves in the western states contain less than 1% sulfur. During the firing of western coal, a decline in the collection efficiency of electrostatic precipitators occurs as a result of western coal's low sulfur content and subsequent high fly ash resistivity. There is insufficient information to assess the effect of coal trace element composition on the environment. Low-sulfur western coal burning plants in the small and intermediate boiler size range generally meet the Federal sulfur dioxide regulation (1.2 lb SO2/million Btu). The best market potential for western coal based on local rail coal transportation is the northeast central and northwest central regions.

77858

Beltzer, Morton

PARTICULATE EMISSIONS FROM PROTOTYPE CATALYST CARS. Exxon Research and Engineering Co., Linden, N. J., Products Research Div., Environmental Protection Agency Contract 68-02-1279, Program Element 1AA002, ROAP 21BCE-03, Rept. EPA-650/2-75-0[illegible], 134p., May 1975. [illegible] refs. NTIS: PB 244[illegible]/AS

Particulate emissions from a vehicle equipped with a variety of commercial and prototype catalyst systems were measured and characterized. The catalysts used comprised four monolithic and three pelleted oxidation catalysts and two nitrogen oxide reduction catalysts. The 1975 Federal Test Procedure was used. Particulate emissions increased due to the formation of sulfuric acid from exhaust sulfur dioxide. Sulfates and associated bound water were the predominant components of the exhaust particulates, followed by minor quantities of organic particulates and metal-derived particulate (mostly iron). The relative contributions of the latter two types of particulate decreased with increasing fuel sulfur content. Substantial differences in the sulfuric acid formation tendency of different oxidation catalysts were observed. (Author summary modified)

76880

Hare, Charles T.

METHODOLOGY FOR DETERMINING FUEL EFFECTS ON DIESEL PARTICULATE EMISSIONS (FINAL REPORT). Southwest Research Inst., San Antonio, Tex., Environmental Protection Agency Contract 68-02-1230, Program Element 1AA002, ROAP 26AAE-15, Rept. EPA-650/2-75-056, [illegible]p., March 1975. 9 refs. NTIS: PB 241160/AS

A method for evaluating fuel and fuel additive effects on diesel engine particulate emissions was developed. A two-cycle engine and a four-stroke cycle engine were operated in both individual steady-state modes and according to a variation of the 13-mode diesel emissions measurement procedure. Both engines were operated on three fuel types, each of which was used with one of two diesel fuel additives as well as by itself. The primary particulate sampling technique employed was a dilution tunnel. Secondary evaluation techniques included a diluter sampler, a light extinction smokemeter, and a filter-type sampling smokemeter. Particulate mass rates were calculated from gravimetric data. The chemical analyses included: sulfur, carbon, hydrogen, and nitrogen in particulate; total organic solubles; sulfur, carbon, hydrogen, nitrogen, and oxygen in organic solubles; benzo(a)pyrene; metals content; and paraffin fractions. Specific particulate emission rates were strongly influenced by fuel type and by the presence of an organometallic smoke suppressant additive. The composition of organic solubles was primarily hydrocarbon material. (Author summary modified)

77331

Fennelly, Paul F.

PRIMARY AND SECONDARY PARTICULATES AS POLLUTANTS. J. Air Pollution Control Assoc., 25(7):697-704, July 1975. 58 refs.

Primary and secondary particulates are discussed with respect to their size distribution, origin, and chemical composition. Primary particulates are particles that are injected directly into the atmosphere. Usually their sizes are within the range 1-20 micron. Common sources are windblown soil, industrial emissions, and combustion systems. Examples of typical primary particulates are soot, pollen, fly ash, and dust. Secondary particulates are relatively small; their size range is 0.01 to 1.0 micron. They can be generally classified as sulfate, nitrates, or hydrocarbons. Secondary particulates are formed as a result of atmospheric reactions involving gaseous species such as sulfur dioxide, nitrogen oxides, oxygen, ammonia, water, and hydrocarbons. The proposed mechanisms for a number of these reactions are outlined and their relative importance is discussed. The impact of both primary and secondary particulates on health and esthetics is discussed. (Author abstract modified)

77864

Ensor, D. S., T. A. Cahill, and L. E. Sparks

ELEMENTAL ANALYSIS OF FLY ASH FROM COMBUSTION OF A LOW SULFUR COAL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 13 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.7.)

Elemental composition as a function of particle diameter was determined for fly ash resulting from the combustion of low sulfur coal. A cascade impactor with a back-up filter was used to collect fly ash samples at the inlet and outlet of a fluidized bed scrubber, and the particulate matter collected was analyzed by an ion-excited X-ray technique. An enrichment of sulfur, copper, and zinc was noted at the scrubber inlet. This enrichment was possibly due to evaporation of volatile elements during combustion followed by condensation on more inert materials when the stack gases cooled. The three same elements were also enriched at the scrubber outlet. The increase in S was possibly a partial result of gas to particle conversion within the scrubber. An enrichment of the scrubber exhaust as a function of particle size was possibly due to the entrainment of mist containing soluble elements. The enrichment of the soluble elements potassium, calcium, manganese, nickel, copper, and zinc relative to silicon (the standard) for both large and small particles was unexpected. A possible explanation for this enrichment involved the bubble mechanism of the fluidized bed scrubber which was packed with plastic balls.

77665

Morgenstern, L. H., P. Morgenstern, C. E. Mears, and D. H. Barrett

AIR QUALITY MODELING ANALYSES OF POWER PLANTS FOR FUEL CONVERSION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.6.)

Diffusion modeling analyses for 61 east coast power plants at which selected units were considered as candidates for fuel conversion from oil- to coal-firing were performed to evaluate the potential impact of these conversions on ambient sulfur dioxide and particulate concentrations. All of the fuel conversions appeared to permit attainment of the primary annual SO2 and particulate ambient air quality standards. Fuel conversions at 38 of the plants did not appear to endanger attainment of the primary 24-hour suspended particulate standard, and attainment of the primary 24-hour SO2 standard did not appear to be jeopardized at 37 of the plants. All of the plants indicated attainment of the 24-hour suspended particulate standard for the 1972 base year, and 53 of the plants indicated attainment of the 24-hour SO2 standard. The fuel conversion at 36 plants where attainment of all standards was possible was estimated to result in an annual reduction in fuel oil usage of about 1 billion gallons. The largest reduction in fuel oil was projected for the New York-New Jersey area followed by the New England states. (Author abstract modified)

77667

Anderson, Michael K.

POWER PLANT IMPACT ON AMBIENT AIR: COAL VS. OIL COMBUSTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.5.)

Total suspended particulates, sulfur oxides, and nitrogen oxides were monitored for specific wind conditions in the vicinity of a steam electric power plant over a 1-month period to determine the effect of coal-firing versus oil-firing on ambient pollutant levels. Air pollution levels were significantly lower during oil firing than during coal firing. Monitoring data obtained downwind of the plant over a 24-hour period revealed a 37% reduction in NOx, a 90% reduction in SOx, and a 10% reduction in total suspended particulate levels when oil was consumed in place of coal. The best method for comparing 24-hour pollutant samples to hourly wind direction readings involved establishing correlations between the pollutant concentrations and the number of hours that the wind blew across the source to the site. Maximum potential impact calculations suggested that primary and secondary 24-hour SO2 standards are in danger of being exceeded if coal is burned at the plant. The prevention of this requires keying period of coal combustion to suitable meteorological conditions or operation of the plant at less than full coal combustion capacity. (Author abstract modified)

77680

Cowherd, Chatten, Jr., James H. Southerland, and Charles O. Mann

METHODOLOGY FOR A NATIONAL EMISSIONS INVENTORY OF FUGITIVE DUST SOURCES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. 17 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-30.2.)

The methodology used to compile data for a national emissions inventory of fugitive dust emissions (unpaved roads, construction sites, agricultural land tilling, and unpaved air strips) is described. Data on the extent of each source category and on the correction parameters which adjust emissions estimates for variations in texture (silt content) and average moisture content of the emitting surface were compiled for each of more than 3000 counties in the United States. Calculation schemes ranged from the apportioning of state-wide measures of source extent to the analysis of geographical maps of climatic and soil properties. The tabulations are being entered into the National Emissions Data System for computation of a national fugitive dust emissions inventory. Average values of corrected emission factors are presented for each state. Estimates of the possible error in the calculated data range from + or - 15% to + or - 30%. (Author abstract modified)

77703

Kaplan, Lawrence and Peter Franconeri

DETERMINATION AND EVALUATION OF STACK EMISSIONS FROM MUNICIPAL INCINERATORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-38.1.)

Performance and stack emissions tests were performed on three large capacity municipal incinerators in New York City. The tests were performed on two electrostatic precipitators and one scrubber serving the incinerators. The gaseous and particulate components leading into the control devices were considerably lower than accepted incinerator furnace emission factors. The electrostatic precipitators, when adequately designed, met the present particulate emission regulations for municipal incinerators with an adequate safety margin for possible future stricter laws. Precipitators downstream of spray towers appeared capable of meeting future laws covering gaseous emissions from incinerators. Either up-flow or down-flow gas spray towers worked satisfactorily with precipitators to meet required efficiencies. However, the down-flow towers removed a larger amount of gaseous pollutants. Electrostatic precipitators limited emissions to an average of approximately 7 lb of particulate/hr. Electrostatic precipitators also averaged 11% sulfur dioxide removal, 73% hydrochloric acid fume removal, 60% chloride removal, and 33% removal for organic gases. Gas sampling results are also reported ammonia, aldehydes, organic acids, ozone, nitrogen dioxide, hydrocarbons, carbon monoxide, and nitric oxide.

77736

Kosky, Kennard F. and Martin P. Wanielista

FUGITIVE PARTICULATE FROM HIGHWAY CONSTRUCTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-56.6.)

The air quality impact of highway construction activities was assessed by collecting 133 24-hour high-volume samples at nine sampling locations at various distances and elevations with respect to the construction site. Violations of the primary and secondary air quality standards for particulate matter (24-hour) were observed 1.4 and 15.0% of the valid sampling time, respectively. Particle size distributions ranged from 1.7-7.5 micron. The occurrence of precipitation reduced mean particulate concentrations by about 31%. The particulate concentration also decreased rapidly with increasing distance from the road. The largest number of high total suspended particulate concentrations was observed when the wind direction was at a 45 degree angle from the direction of the roadway. (Author abstract modified)

77829

Jacko, Robert B. and James P. Loop

A PARAMETRIC STUDY OF AN OPEN HEARTH FURNACE PARTICULATE EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 16 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-15.2.)

Operating parameters affecting particulate emissions from a typical basic open hearth steel making furnace were studied. Consecutive 15-minute emission samples were extracted from the furnace gathering flue with a modified Andersen sampling head and the standard Environmental Protection Agency train. This resulted in the characterization of emissions with process time. The major process parameters that were varied during the study were the percentages of hot metal, number two dealer scrap, and oxygen lancing. Overall emissions varied by as much as 10 to 1 during a typical 8-hour heat. Maximum oxygen usage resulted in maximum particulate emissions; and the lowest oxygen usage resulted in minimum emissions, with the minimum occurring typically for 50% hot metal addition levels. The amount of dealer scrap charged with each of the hot metal additions exerted a smaller effect on the overall emissions as compared to the use of oxygen. Doubling the amount of oxygen resulted in a doubling of the particulate emission level, while only a 50% increase was observed over the full range of number two dealer scrap. The median particle diameter of emissions sampled during each of seven heats was 1.1 micron. (Author abstract modified)

78512

Hindman, Edward E., II, Peter V. Hobbs, and Lawrence F. Radke

AIRBORNE INVESTIGATIONS OF AEROSOL PARTICLES FROM A PAPER MILL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 18 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.6.)

Airborne measurements were made in the effluent of a Kraft-process paper mill and in nearby air unaffected by the mill using a new particle sampling facility which integrates the data from five instruments. The aerosol particle measurements demonstrate that the effluent from the paper mill is a significant and consistent source of particles with diameters greater than 0.05 micron. The effluent contains fewer particles smaller than 0.05 micron than nearby air, indicating that enhanced coagulation of particles may be occurring in the mill's effluent and not occurring in the nearby air. The effluent from the mill is a significant source of large and giant cloud condensation nuclei (CCN), but not a significant source of small CCN. These large and giant CCN account for the anomalously large drops which are observed in clouds located in the effluent of the paper mill investigated. (Author abstract modified)

79163

O Keefe, Lawrence F.

MODELING INCINERATOR FLUE TRAIN PERFORMANCE WITH A DIGITAL COMPUTER. American Society of Mechanical Engineers, New York, Incinerator Div., Natl. Incinerator Conf., Energy Recovery Thru Incineration, Miami, Fla., 1974, p. 175-178. 3 refs. (May 12-15.)

A mathematical model which characterizes incinerator flue gas in terms of temperature, weight and volume flow, moisture content, pressure drop, and particulate content as it travels from the grate bed to the stack is described. Furnace and flue train design data are fed into the model along with refuse composition and forced draft air flow rates, and a computer provides printouts of flue gas conditions at each point in the flue train for each combination of refuse composition and air flow. The contaminant loading section of the model uses an empirical equation to calculate the weight of fly ash generated. Each contaminant removal process is assigned its own removal efficiency value or equation, and the amount of contaminant remaining is calculated at these points. An electrostatic precipitator subroutine calculates the particulate contained in the flue gas exiting to the atmosphere as a function of inlet dust loading and gas velocity. Energy recovery processes can be modeled by adding a waste heat boiler subroutine or, in the case of a waterwalled furnace, adding equations to the furnace subroutine. The model is useful for understanding the range of conditions during operation and for designing the incinerator and control equipment for minimum pollutant generation. (Author abstract modified)

80010

Lillis, Edward J. and Dexter Young

EPA LOOKS AT FUGITIVE EMISSIONS. J. Air Pollution Control Assoc., 25(10):1015-1018, Oct. 1975. 6 refs.

The characteristics of fugitive emissions (industrial) and fugitive dust emissions are described. Fugitive emissions include both gaseous and particulate emissions that result from industrial related operations and which escape to the atmosphere through windows, doors, and vents, but not through a primary exhaust system, such as a stack, flue, or control system. Fugitive emissions result from metallurgical furnace operations, materials handling, transfer, and storage operations, and other industrial processes where emissions escape to the atmosphere. Fugitive dust emissions are generally related to natural or man associated dusts (particulate only) that become airborne due to the forces of winds, man's activity, or both. Fugitive dust emissions include windblown particulate matter from unpaved dirt roads, tilled farm lands, and exposed surface areas at construction sites. Natural dusts that become airborne during dust storms are included as fugitive dusts.

80679

Cross, Frank L., Jr. and J. Ronald Lawson

A NEW PETROLEUM REFINERY – THE ENVIRONMENTAL IMPACT. AIChE Symp. Ser., 70(137):808-816, 1974. 17 refs.

A mathematical diffusion model is used to estimate the environmental impact of a hypothetical 100,000 barrel/day refinery located in the densely populated city of Providence, Rhode Island. Estimated sulfur dioxide, total particulate, and carbon monoxide emissions from the refinery are 1800, 867, and 1318 tons/yr, respectively, as compared with total contributions from other sources in the area of 119,100, 31,000, and 437,300 tons/yr, respectively. Such estimates in combination with determinations of the costs of alternative control methods are useful in site selection considerations. A general outline of a typical environmental impact statement is presented.

82797

Burchard, John K.

THE SIGNIFICANCE OF PARTICULATE EMISSIONS. J. Air Pollution Control Assoc., 24(12):1141-1143, Dec. 1974.

The emission of fine particulates is discussed in terms of their effect on human health, industrial sources of their emission, and methods for their control. The principal health effect of fine particulates (less than 1 micron in diameter) results from inhalation and direct attack on the respiratory system which may be manifested by short term irritant effects or longer term damage in the form of emphysema, bronchitis, or pneumoconiosis. Major industrial sources of fine particulate emissions can be priority ranked as follows: ferro-alloy furnaces, steel-making furnaces, coal-fired power plants, lime kilns, kraft pulp mill recovery furnaces, municipal incinerators, iron foundry cupolas, crushed stone plants, hot-mix asphalt plants, and cement kilns. Although electrostatic precipitators and fabric filters can remove fine particles down to 0.1 micron with efficiencies around 99.99%, the range of applicability of these control devices is limited by operating conditions and particulate properties.

84716

Barrett, R. E., D. W. Locklin, and Robert E. Hall

FIELD INVESTIGATION OF EMISSIONS FROM COMMERCIAL BOILERS. Preprint, Battelle Columbus Laboratories, Columbus, Ohio and Environmental Protection Agency, Research Triangle Park, N. C., 10p., 1976. 10 refs. (Presented at the Air Pollution Control Association Specialty Session Proceedings, 67th, June 1974.) NTIS: PB 251919/AS

Information on air-pollutant emissions from commercial boilers was developed in a 2-year field investigation conducted by Battelle's Columbus Laboratories for the American Petroleum Institute and the U. S. Environmental Protection Agency. Particulate, smoke, carbon monoxide, hydrocarbons, nitrogen oxides, and sulfur dioxide emissions from 11 typical commercial boilers were measured to determine the effects on emissions of various combustion parameters and fuel oil compositions. Emissions were measured for 31 different combinations of boilers and fuels at various loads and excess air settings. Burner adjustments had a marked effect on particulate and smoke emissions. Fuels included in the investigation were natural gas and five grades of fuel oil. Fuel characteristics had a significant effect on emissions, especially particulate and NO_x. Particulate emissions with the 1% sulfur oil averaged about 50% of those for conventional No. 6 oil with sulfur content averaging about 2%. Particulate emissions for No. 2 oil averaged only about 5% of those for No. 6 oil. Emissions of NO_x were lowest with gas and the lighter grades of fuel oil. An empirical correlation was developed relating NO_x with the nitrogen content of fuel oils. New emission factors (with a distinction between fuel-oil grades) are suggested for use in emission inventories and in evaluating control strategies. A reference document, Guidelines for Burner Adjustments of Commercial Oil-Fired Boilers, was prepared for use by service technicians in adjusting commercial oil-fired boilers to minimize emissions and to maintain efficiency. (Author abstract)

84717

Ward, Darold E., Charles K. McMahon, and Ragnar W. Johansen

AN UPDATE ON PARTICULATE EMISSIONS FROM FOREST FIRES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1976. 20 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-2.2.)

Recent estimates of particulate production from forest fires in the United States have ranged from 500,000 to 54,000,000 tons annually. This has been partly due to disparities in estimates of fuel that is consumed during the combustion process, but more to the choice of emission factors used to compute particulate production. The published data are reviewed, and new National estimates for 2 main categories of fires (wildfires and prescribed fires) are proposed. The emission factors for wildfires and prescribed fires are 150 and 50 pounds/ton, respectively; the annual particulate production is 1,500,000 ton and 410,000 ton, respectively. The wide range of presently quoted emission factors, between 10 and 200 lb/ton for different fire behavior and fuel characteristics, is discussed. Grouped with the prescribed fire category are both low-intensity fires (used mostly in the South to reduce understory litter) and fires used for disposal of logging debris (slash fires). In addition, estimates summarizing particulates production on a seasonal-regional basis are also presented in order to underscore the need to recognize the cyclic and intermittent nature of the forest burning source.

84723

Wilson, William E., Lester L. Spiller, Thomas G. Ellestad, Paul J. Lamothe, Thomas G. Dzubay, Robert K. Stevens, Edward S. Macias, Janja D. Husar, Rudolf B. Husar, Kenneth T. Whitby, David B. Kittelson, and Bruce K. Cantrell

GENERAL MOTORS SULFATE DISPERSION EXPERIMENT: SUMMARY OF EPA MEASUREMENTS. Preprint, the Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1976. 19 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976. Paper 76-33.6.)

A study was conducted to measure potential sulfate exposures from a fleet of cars using catalyst-equipped motors in controlled, simulated highway driving conditions and under many different meteorological conditions. A fleet of 352 catalyst-equipped cars was run on a 10 km north-south straightaway. The cars ran for 3 hours at 80 km/hr, equivalent to a traffic density of about 5500 vehicles/hr on a 4-lane highway. The gasoline was unleaded and blended to contain 0.03 wt% sulfur. Samplers are operated upwind and downwind of the road for later analysis of sulfur and other elements by X-ray fluorescence. Sulfuric acid, sulfate, and aerosol size distribution measurements were made inside one of the test vehicles. Sulfuric acid, aerosol size distribution, ammonia, and sulfur dioxide measurements were made 20 meters downwind of the road. The particulate sulfur emissions rate was determined from a measurement of the sulfate mass flow rate 17 meters downwind. It was found that sulfuric acid aerosol (Aitken nuclei mode, geometric mean diameter about 0.02 micron) was emitted in the exhaust of the catalyst-equipped vehicles. Measurement of substantial amounts of sulfuric acid 30 m downwind of the road indicated a lack of complete neutralization by ammonia. When the wind was perpendicular to the road, there was no coagulation of sulfuric acid in the accumulation mode, geometric mass diameter of about 0.34 micron. When the wind was parallel to the road, the higher concentration of aerosol and the increased residence time led to coagulation of about one third of the sulfuric acid aerosol into the accumulation mode. From measurements of the aerosol sulfur mass flow rate, the aerosol sulfur emission rate/car was determined to be 3.3 plus or minus 0.8 microgram/m, corresponding to a 12 plus or minus 3% conversion of fuel sulfur into emitted aerosol sulfur.

84734

Giammar, Robert D., Richard B. Engdahl, and Richard E. Barrett

PARTICULATE AND POM EMISSIONS FROM A SMALL COMMERCIAL STOKER-FIRED BOILER FIRING SEVERAL COALS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1976. 6 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-5.2)

The stoker design, stoker operation and firing procedure, and type of coal burned is related to the levels of emission of smoke, nitrogen oxides, sulfur oxides, carbon monoxide, particulates, and POM. It is demonstrated that smokeless operation of small commercial stokers can be achieved with minor modifications in the stoker design (by providing for overfire air) and accurate control of the combustion air. The data indicate that a relatively large amount of particulate and POM emissions are generated during the off-cycle in which there is no control over the air supply. Emissions might be reduced during this cycle by maintaining a control of the air flow to and above the fuel bed. Anthracite coal proved most suitable for stoker firing. Western subbituminous coal can be used with minor modifications in the design and operation of the stokers.

84736

Boyer, Kenneth W. and Herbert A. Laitinen

AUTOMOBILE EXHAUST PARTICULATES: PROPERTIES OF ENVIRONMENTAL SIGNIFICANCE. Environ. Sci. Technol., 9(5):457-469, May 1975. 30 refs.

The physical and chemical properties of automobile exhaust particulates were investigated. The particulates were collected with a specially designed collection apparatus from a 1971 Ford V-8 engine operating at warmed-up cruise conditions. Analysis by gas chromatography-mass spectroscopy of the ether extract of the submicrometer exhaust particulates showed the presence of hundreds of compounds, including about 50% saturated aliphatic, 5% polynuclear aromatic, and 30% oxygenated hydrocarbons. Irradiation of exhaust particulates with ultraviolet light caused photochemical degradation of the organic material associated with the particulates. The presence of lead halides appeared to enhance the rate of photodecomposition of exhaust particulates. (Author abstract)

84743

Dana, M. Terry, R. N. Lee, and E. J. Schilde

PARTICULATE AND SO2 EMISSIONS FROM PROCESS HEATERS AT SHELL AND TEXACO REFINERIES, ANACORTES, WASHINGTON. Battelle, Pacific Northwest Laboratories, Richland, Wash., EPA Contract 68-02-1409, Task 17, 68p., Sept. 1975.

In response to a need for more up-to-date emission factors for petroleum refinery process heaters, measurements were made of sulfur dioxide and particulate emissions from such sources. The measurements were made at the Texaco CO Boiler and Shell Crude Heater F-101 and were of three types: total particulate (EPA Method 5), particle size distribution (Andersen impactor), and sulfur dioxide (EPA Method 6). Because fuel mixtures can vary in normal operation of these plants, at least four total particulate runs were performed at each location. Two of these runs at each plant were conducted under high oil firing conditions, and the other two under low oil conditions. The high oil condition at one of the plants was selected for SO2 and Andersen impactor sampling. The sampling points at each plant were located at the effluent stack. The measurement results are given. (Author abstract)

84747

SUMMARY OF PARTICULATE AND SULFUR OXIDE EMISSION REDUCTIONS ACHIEVED NATIONWIDE FOR SELECTED INDUSTRIAL CATEGORIES, 1970-1974 (FINAL REPORT). Environmental Protection Agency, Washington, D. C., Div. of Stationary Source Enforcement, Rept. EPA 340/1-76-001, 13p., Jan. 1976.

The results of 4 years of local, state, federal, and industry efforts to reduce the amount of particulates and sulfur oxides being emitted into the atmosphere by stationary sources are summarized. Emission reductions for selected industrial categories are summarized and compared to the reduction goal planned for the time period. The results (presented in graphs and tables) are discussed separately for each pollutant and each industry as well as for the nation as a whole. Results are expressed in terms of controlled emissions: the difference between potential and actual emissions for specific source categories. For example, between 1970 and 1974, potential SOx emissions increased by 13% (from 39.6 to 44.7 million tons/yr), but the overall degree of control increased from 15 to 30%, resulting in an 8% reduction in actual emissions. By the end of 1974, 7.6 million tons/yr of SOx were being controlled that were not being controlled in 1970. Actual particulate emissions also declined from 1970 to 1974, (from 27.5 to 19.5 million tons/yr), while the potential for emissions increased, because the overall degree of control also increased. Industries for which results are discussed include: coal-fired steam electric power plants; oil-fired steam electric power plants; coal-fired industrial/commercial boilers; integrated iron and steel mills and coke plants; petroleum refineries; primary copper, lead, zinc, and aluminum smelters; Portland cement plants; municipal refuse incinerators; sulfuric acid plants; phosphate fertilizer plants; ferroalloy plants; asphalt concrete plants; coal cleaning plants; kraft and sulfite pulp mills; and grey iron foundries.

84748

Cowherd, Chatten, Jr. and Charles O. Mann

QUANTIFICATION OF DUST ENTRAINMENT FROM PAVED ROADS. Midwest Research Institute, Kansas City, Mo., Contract EPA 68-02-1403, Task 7, Rept. 76-54, 14p., 1976. 9 refs.

This paper presents the results of a field testing program to develop emission factors for fugitive dust entrainment from paved urban roadways. Substantial evidence has been compiled which indicates that dust emissions from city streets are a major cause of nonattainment of national air quality standards for total suspended particulates (TSP). Therefore, the quantification of this source is necessary in the development of effective attainment and maintenance strategies. The sampling program was conducted at representative sites in the Kansas City area. At one location, controlled amounts of pulverized top soil and gravel fines are applied to the road surface. The basic measurements consisted of isokinetic dust exposure and concentration profiles, particle size distributions, dust deposition profiles, surface dust loadings, and traffic characteristics. In addition, conventional high volume samplers were used to determine attenuation of TSP concentration with distance from the source. Emissions were found to vary directly with traffic volume and surface loading of silt (fines), which in turn is related to land use. Estimated emission factors for particles smaller than 30 micrometers in diameter, as a function of land use, range from about 1 to 13 g/vehicle-mile, of which about two-thirds consists of particles smaller than 5 micrometers. (Author abstract)

84756

Tanner, R. L. and L. Newman

CHEMICAL SPECIATION OF SULFATE EMISSIONS FROM CATALYST-EQUIPPED AUTOMOBILES UNDER AMBIENT CONDITIONS. Environmental Protection Agency, EPA-600/3-76-035, 13p. 9 refs. In: The General Motors/Environmental Protection Agency Sulfate Dispersion Experiment: Selected EPA Research Programs, April 1976.

Airborne particles samples were obtained on treated quartz filters during five days of the General Motors (GM) Sulfate Dispersion Experiment and analyzed for total acidity, sulfuric acid, ammonium, soluble sulfate (two methods), total sulfur and nitrate. From the resultant data it is concluded that the immediate roadside impact from sulfate emissions by catalyst-equipped autos is of the order of 1.6 microgram/cu m, probably all in the form of sulfuric acid (in agreement with EPA and EPA contractor data). This particulate sulfuric acid emission is neutralized by ambient ammonia with a half-life of tens of seconds, the rate apparently dependent on the ambient ammonia concentration. Experimental examples of (a) sulfuric acid impact; (b) ammonia-neutralized sulfate impact; and (c) partially neutralized sulfate impact at 30 meters (or 100 meters) downwind from the roadway are cited. (Author abstract)

84759

Macias, E. S., R. A. Fletcher, J. D. Husar, and R. B. Husar

PARTICULATE SULFUR EMISSION RATE FROM A SIMULATED FREEWAY. Environmental Protection Agency, EPA-600/3-76-035, 34p. 6 refs. In: The General Motors/Environmental Protection Agency Sulfate Dispersion Experiment: Selected EPA Research Programs, April 1976.

The particulate sulfur emission rates from a roadway traversed by catalytic converter equipped cars was determined by measuring the particulate sulfur concentration profile and vertical wind velocity profile 15 m from the edge of the road. Filter samples were collected in half-hour intervals with two stage samplers and were subsequently analyzed for sulfur, using the flash vaporization-flame photometric detection method. Particulate mass was also monitored with a beta attenuation mass monitor. The sulfur flow rate for this experiment was found to be 5.1 + or - 1.5 microgram/m/sec and the sulfur emission rate/car was 3.3 + or - 0.8 microgram/m. This corresponds to a 15 + or - 10% conversion of the fuel sulfur emitted as particulate sulfur. It was also found that sulfur accounted for approximately 20% of the fine particulate mass. Measurements in an automobile indicated that the sulfur concentrations on the roadway and inside a passenger vehicle were comparable and were similar to the concentrations measured 15 m downwind. (Author abstract)

84760

Whitby, K. T., D. B. Kittelson, B. K. Cantrell, N. J. Barsic, D. F. Dolan, L. D. Tarvestad, D. J. Nieken, J. L. Wolf, and J. R. Wood

AEROSOL SIZE DISTRIBUTIONS AND CONCENTRATIONS MEASURED DURING THE GENERAL MOTORS PROVING GROUND SULFATE STUDY. Environmental Protection Agency, EPA-600/3-76-035, 40p. 12 refs. In: The General Motors/Environmental Protection Agency Sulfate Dispersion Experiment: Selected EPA Research Programs, April 1976.

In October 1975, General Motors (GM) and the Environmental Protection Agency (EPA) conducted a freeway simulation study at the GM Milford Proving Ground, using only catalytic converter equipped cars. During the study, nearly 800 aerosol size distribution measurements were made, both on the test track and close by. At the same time, sulfate measurements were also made by other experimental teams. Background aerosol volume size distributions measured during the test show three distinct modes with mean sizes of approximately 0.03, 0.24 and 8.0 micron. Aerosol distributions measured during the run, both on and off the track, also exhibit three modes. Those at 0.24 and 8.0 remain essentially unchanged while the smaller mode contains much more volume than the background aerosol, and now has a mean size of about 0.02 micron. The exact amount of the increase in volume of the smallest mode is greatly dependent on meteorological parameters. This was seen to vary from about 80 cu micron/cu cm, when the wind direction was parallel to the track, to 5 cu micron/cu cm, when the wind blew across the track. On days when the wind was parallel to the track, approximately 1/3 to 1/2 of the increase in volume during the test runs over background appeared in the 0.24 micron mode. No increase of the 0.24 micron mode was noted when the wind blew across the track. The primary aerosol volume emission was of a mean size of 0.02 micron. (Author abstract)

84761

Lamothe, Paul J., Thomas G. Dzubay, and Robert K. Stevens

CHEMICAL CHARACTERIZATION OF AEROSOLS PRESENT DURING THE GENERAL MOTORS SULFATE DISPERSION EXPERIMENT. Environmental Protection Agency, EPA-600/3-76-035, 27p. 12 refs. In: The General Motors/Environmental Protection Agency Sulfate Dispersion Experiment: Selected EPA Research Programs, April 1976.

A study was conducted during October 1975 at General Motors Milford Proving Ground to measure the chemical properties of sulfate emissions from a fleet of catalyst equipped vehicles under controlled highway driving conditions. Aerosol samples were collected with dichotomous samplers and were analyzed by both X-ray fluorescence spectrometry and wet chemical procedures for strong acid, ammonium and sulfate content. In addition sulfuric acid, ammonia and sulfur dioxide measurements were obtained. The peak sulfate concentrations ranged from 5.4 to 5.7 microgram/cu m above background and the sulfuric acid concentrations ranged from 1.7 to 5.4 microgram/cu m. Because significant amounts of sulfuric acid were measured at 20 m downwind of the roadway, it can be assumed that the product of the ammonia concentration and transport time from the roadway to the monitor was insufficient to cause complete neutralization of the sulfuric acid. (Author abstract)

84764

Barrett, R. E. and A. A. Putnam

BOILER EMISSIONS—AN INVENTORY OF EMISSIONS BY BOILER SIZE AND USE. Preprint, Air Pollution Control As-

Inc., Pittsburgh, Pa., 17p., 1976. 16 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-6.6.)

Using available data sources, a compilation of the boilers in use in the Continental United States was made by boiler size, fuel, and boiler type. Residential, commercial, industrial, and utility boilers were included in the study. Primary data sources included the National Emissions Data Bank (NEDS) data, American Boiler Manufacturers Association boiler sales data, and earlier reports to the Environmental Protection Agency. Allowance was made for the fact that no single data source was complete. Therefore, the data from the various sources was manipulated to arrive at a composite inventory of boilers in use. Results are presented in the form of graphical displays of (1) cumulative actual boiler use, both versus boiler size; and (2) cumulative sulfur dioxide, nitrogen oxides, and particulate emissions versus boiler size. Boiler design capacity, actual use, and emissions are presented for each major boiler fuel and for the total of all fuels. (Author abstract)

84700

Chalekode, Parasuraman K. and Thomas R. Blackwood

A STUDY OF EMISSIONS FROM AGGREGATE PROCESSING. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1976. 6 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-36.4.)

Particulate emissions from aggregate processing are discussed. Sampling at representative aggregate plants indicates that the emission factor for total particulates range from 1 gram/metric ton (0.002 pound/ton) to 210 grams/metric ton (0.42 pound/ton) processed through primary crusher. Six percent (±1%) of these emissions are respirable less than 7 micron. This emission is lower than emission estimates previously available. Possible explanation of this difference is discussed. Unit operations such as drilling, blasting, unpaved road traffic, crushing and screening contribute to more than 90% of the overall plant emissions. An analysis of the emissions shows that the mean free silica content ranged from 1% to 20%. Trace element analysis and fiber counting showed their levels to be too low to affect the ambient air quality significantly. Samples of unpaved road surface material were collected from various aggregate plants across the United States and the respirable portion was analyzed for free silica. The mean free silica content was 14% with a range of 1.4% to 47%. An error analysis on the emissions and composition values has been included, where applicable. (Author abstract)

B. CONTROL METHODS

[illegible]

Chiaro, D. A.

SIGNIFICANT OPERATING BENEFITS REPORTED FROM CEMENT QUARRY DUST CONTROL PROGRAM. Pit Quarry, 63(7):[illegible]-118, Jan. 1971.

A systematic soil stabilization program has been practiced for a number of years by the Arizona Portland Cement Company to control dust conditions on miles of unpaved roads at its cement stone quarry near Tucson. Regular dust control treatments utilizing a special emulsion agent called Coherex make hauling easier and safer for drivers, and make truck washings necessary only at seven week intervals rather than on a once-a-week basis. A technique was developed to mix the emulsion with the hard crust of the road surface, while water is sprayed lightly over the surface once each working shift to keep the Coherex binder active. Maintenance and special conditions are mentioned, including the treatment of new road beds and weak sub-grades.

[illegible]

Sproull, Wayne T.

MINIMIZING RAPPING LOSS IN PRECIPITATORS AT A 2000 MEGAWATT COAL-FIRED POWER STATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., [illegible]p., 1971. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-154.)

To determine how rapping loss varied with the intensity, duration, and time interval between raps, field tests were conducted at a 2000 megawatt coal-fired power station where precipitators were designed to collect 99.5% of the fly ash in the combustion gas. The amount and location of the rapping losses were determined by using an instrument called the Konitest. Working on a triboelectric principle, it permits one to measure rapidly changing ash or dust concentrations at any chosen point within an operating precipitator, recording these data automatically on a strip chart. Thus the places where losses occur are quickly found, and the effect of changes in rapping technique are immediately made evident. The rapping loss could be reduced from about 4% to less than 1% by rapping the inlet, intermediate, and outlet sections of the precipitator in a 1:2:1 frequency ratio; completing and repeating the rapping sequence every 12 min; and considerably reducing the rapping intensity from the level previously used. (Author abstract modified)

[illegible]

Corn, Morton and Robert T. Cheng

INTERACTIONS OF SULFUR DIOXIDE WITH INSOLUBLE SUSPENDED PARTICULATE MATTER. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., [illegible]p., 1972, 18 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-[illegible].)

A laboratory study was conducted of the heterogeneous catalysis of sulfur dioxide at ppm concentrations in air by insoluble particles of calcium carbonate, vanadium pentoxide, ferric oxide, fly ash from a coal-burning powerplant, manganese dioxide, activated carbon, and suspended particulate matter from urban air. A new technique for aerosol stabilization was utilized which consisted of depositing the aerosol on Teflon beads in a fluidized bed. The Teflon beads with deposited aerosol particles were then packed into a flow reactor. Progress of the chemical reaction with deposited particles was continuously monitored by determining the SO_2 concentrations in the reactor effluent with a microcoulometer. The $CaCO_3$, V_2O_5, and fly ash were essentially inert to SO_2 at room temperature. The Fe_2O_3, activated carbon, MnO_2, and suspended particulate matter from urban air sorbed SO_2 from air streams with up to 14.4 ppm SO_2 in air. A substantial part of the sorbed SO_2 was physically adsorbed. Bioassay procedures which utilize pulmonary flow resistance changes in guinea pigs to monitor response to inhaled SO_2-aerosol mixtures in air have indicated the weak or non-potentiating capacity of insoluble aerosols as contrasted to soluble aerosols. Potentiating response of an aerosol appears to be strongly associated with reaction of SO_2 in a water droplet containing aerosol ions and not with physically adsorbed SO_2 on an insoluble aerosol. (Author abstract modified)

[illegible]

Francis, Fred J.

SECONDARY ALUMINUM SMELTER AIR POLLUTION CONTROL USING A CHROMATOGRAPHIC COATED BAGHOUSE — A TECHNICALLY NEW AND ECONOMIC SOLUTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., [illegible]p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-[illegible].)

The sources of air pollution for secondary aluminum smelters and of chromatographic coated baghouses to control that pollution are described. The secondary aluminum smelting industry consumes aluminum scrap generated by wastage from new factory production or from obsolescence and scrapping of old products. This industry represents approximately [illegible]% of total production of aluminum in the United States. The raw material is scrap, and it comes with pollutants, such as: oil, paint, and plastics, and because of its volume it has to be melted under a flux cover containing salt, potash, cryolite, or fluorspar, which gives off fumes containing chlorides and fluorides. In addition, most of the scrap intake into a smelter consists of wrought alloys containing magnesium (e.g., beer cans). The pollutants in aluminum industry are: carbonaceous particles both combustible and noncombustible, oil particulates, magnesium and aluminum chlorides, chlorine, hydrogen chloride, and hydrogen fluoride. Control methods attempted throughout the world, namely scrubbers, afterburners, and baghouses are reviewed briefly. The reasons for choosing the novel chromatographic coated baghouses are explained. Results of tests from a total of four runs completed utilizing chromatographic coated baghouses are discussed. Samples taken for dust analysis reveal that in all four runs, the amount of emitted dust was down to the minimum (an average of [illegible] grain). The results of runs show it is possible to reduce particulate emission and mixture emissions to virtually zero by means of chromatographic coated baghouses. An analysis is made of operating costs, which are 1/3 to 1/5 of other potential systems, such as scrubbers and afterburners. (Author abstract modified)

44841

Theodore, Louis

APPLICATION OF MODELING AND SIMULATION TECHNIQUES TO THE DESIGN OF VENTURI SCRUBBERS. I. MODEL OF PARTICLE CAPTURE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 33p., 1972. 15 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-101.)

A study was made to develop a satisfactory mathematical model for venturi scrubbers to describe particle collection efficiency as a function of power consumption, and to develop improved design procedures, especially for particle capture. The mechanics of solid capture by the liquid phase is of major importance in predicting the performance of a venturi scrubber. A prerequisite of a model of particle capture is a description of the flow field in the vicinity of the liquid droplet. However, the flow is so complex in this system that it can only realistically be represented by a simplified model. One of the simplest is the free surface or cellular model originally proposed by Happel. This idealized cellular model is assumed to consist of two concentric spheres, the outer sphere representing a fluid envelope having a free surface and containing the aerosol, and the inner sphere containing the droplet. This model can be utilized to predict particle capture. This is accomplished by computing the trajectory of an aerosol particle as the fluid flows around the inner sphere (the liquid collector) in the two-concentric-sphere model. Single particle collection efficiencies for the cellular model are presented for various void fraction values. These are compared with the results for a single collector (unit void volume) in both the creeping motion and potential flow regimes. The results clearly indicate that single particle collection efficiencies are a function of the void void volume. In addition, theory and experimental results for the single collector in the high Reynolds number range are bounded by the viscous cellular model calculations for void fraction values of 0.66 and 0.90. The extension of the single particle collection efficiency model to include the contribution of the entire assemblage of eligible collector cells is presented. The effect of variations in particle velocity, liquid velocity, and void volume, and particle and liquid size distributions on the overall efficiency equation is discussed. (Author abstract modified)

44884

Theodore, Louis and Thomas J. Rasimas

SIMULATION OF AN ELECTROSTATIC PRECIPITATOR : EFFECT OF VELOCITY, PARTICLE SIZE, PARTICLE MASS FLOW RATE AND ELECTROSTATIC FORCE DISTRIBUTION ON COLLECTION EFFICIENCY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 38p., 1972. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-106.)

The behavior of particles in an electrostatic precipitator was simulated in order to predict collection efficiency. One of the contributions of the study is the proposed method of treating system variables not previously mentioned in the literature on the subject. These include particle size distribution as a function of inlet position, particle mass flow rate gradient, gas velocity profile, and the variation of the electrostatic force as a function of particle size and inlet position. The technique used for this purpose is based on the repetitive solution of the describing model, with the magnitude of the variables determined via the selection of a random number. The random number technique is employed to treat the distribution of particle size as a function of inlet position and the electrostatic force as a function of both particle size and inlet position. The distribution effect of several system variables can be included in the describing equations for electrostatic precipitators, such as making the charge and the force a function of time, by substituting functions in the equation. Since the proposed method of solution is more akin to physical experimentation than analytical or numerical methods, it should find application in research and design analysis of electrostatic precipitators. (Author conclusions modified)

44880

Calvert, Seymour, David Leith, and Jhuda Goldshmid

PARTICULATE SCRUBBER APPLICATIONS, PERFORMANCE, AND COSTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-105.)

Criteria for selecting a scrubber, patterns of scrubber application and performance, and cost are described. Results of a survey of scrubber systems in field use are presented. Ten types of scrubbers are identified and defined in terms of their principal mode of operation. Data are presented on the numbers and percentages, collection efficiency, and capacity for each type of scrubber in each unit process. Costs of installed complete scrubber systems are presented for the six scrubber types for which there were sufficient data. These are compared with predictions based on component costs and engineering cost estimation methods. The survey showed that in the majority of the cases there is no knowledge of particle size or concentration. There is also a tendency to forget about the scrubber once it has passed inspection. Costs of scrubbers can be estimated from preliminary designs with about the same accuracy as the usual chemical plant equipment. In general, scrubbers have been utilized successfully in thousands of installations, and will be utilized increasingly in the future. They possess unique capabilities as well as limitations. When properly applied, they can be designed with as much confidence of success as any other type of air pollution control equipment. Packed towers, fiber beds, sprays, venturis, centrifuges, and baffles are used in the chemical industry, incinerators, dryers, stone crushing, foundries, and furnaces.

45086

Selle, Stanley J., Philip H. Tufte, and Gordon H. Gronhovd

A STUDY OF THE ELECTRICAL RESISTIVITY OF FLY ASHES FROM LOW-SULFUR WESTERN COALS USING VARIOUS METHODS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 32p., 1972. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-107.)

The electrical resistivity of fly ashes from low-sulfur western coals was measured by the ASME laboratory method, the point-to-plane in-situ method, and the cyclone resistivity probe in-situ method. Correlation of bulk resistivity with the major fly ash constituents showed that resistivity tends to decrease with increasing sodium monoxide and sulfur trioxide and to increase with increasing silica, aluminum oxide, ferric oxide, calcium oxide, and magnesium oxide. This relationship also applied to in-situ resistivity as measured by the point-to-plane method. Comparison of resistivity values obtained on the same fly ash at 300 F by the ASME and point-to-plane methods showed that, contrary to most published data on

Eastern fly ash, the in situ method generally gave higher values. The in situ results showed no SO_3 surface conditioning of fly ash. With high-alkali ashes, any SO_3 formed evidently reacts quickly with the alkali and is not available for surface conditioning. For the ashes studied, the best predictor of ash resistivity was the ratio $(CaO + MgO)/(Na_2O + SO_3)$. During the next few years the number of new electrostatic precipitators installed for collecting fly ash from plants burning lignites and other low-sulfur Western coals will increase substantially. The data presented may be of value in predicting the performance of these units based on the chemical analyses of the ashes of the coals to be burned.

53743

Bartel, Mark H. and James O. Holland

WATER SPRAYS REDUCE PARTICULATE EMISSIONS FROM ASPHALT PLANT SCRUBBER STACK. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1973. (Presented at Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-327.)

The case history of an asphalt plant which was able to update its dust collection equipment to meet modern air pollution control requirements is presented. Since the asphalt plant begins operations prior to the morning rush hour, the residents driving in from the area mountains could easily spot any visible emissions. The plant received numerous complaints directly from the residents and through the State of Idaho Department of Environmental Protection and Health. When faced with a requirement for source test results, the company developed a wet scrubbing system. Experimentation showed that the addition of three Swirl Air nozzles in the wet scrubber stack greatly reduced visible emissions and eliminated complaints. A source test performed by an independent consulting firm indicated that particulate emissions were at 14.4 lbs/hr at a production rate of 103 tons/hr. This is well below the state code of 51.2 lbs/hr at a production rate of 100 tons/hr. The uniform distribution of finely atomized water droplets in the scrubber was probably a major factor in reducing emissions to an acceptable level. (Author abstract modified)

53921

Theodore, Louis, Joseph P. Reynolds, and Ralph J. Navarrete

RESULTS OF A NEW TECHNIQUE FOR CALCULATING COLLECTION EFFICIENCIES IN ELECTROSTATIC PRECIPITATORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 30p., 1973. 13 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-282.)

Results of a new technique for calculating collection efficiencies of several system variables is presented. The variables include particle size distribution, particle mass flow rate, gradient, gas velocity profile, and the variation of electrostatic force as a function of particle size and inlet position. The calculated results for collection efficiencies are in reasonable agreement with the limited experimental data available in the literature. Variation of precipitator geometry and electrostatic force produce results that are in qualitative agreement with what one would expect, and for a given efficiency, the drift velocity in the model differs considerably from that calculated by the Deutsch - Anderson method. A substantial difference is found between collection efficiencies that are calculated using particles of a single characteristic size and those calculated assuming a distribution of sizes. Because it employs a random assignment of inlet position, size, and charge to each particle being tested, the proposed method of solution is more akin to physical experimentation than analytical or numerical methods, and as such should provide a realistic approach to both the calculation of collection efficiencies and the design of electrostatic precipitators. (Author abstract modified)

53980

Noll, Kenneth E., Wayne T. Davis, and Stephen P. Shelton

NEW CRITERIA FOR THE SELECTION OF FABRIC FILTERS FOR INDUSTRIAL APPLICATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1973. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-141.)

A simple design equation was adapted from filter design theory to allow a rapid initial design for typical bag houses without the need for a historical data bank concerned with filter operations. The basic equation is S1 equals K2 (W1 + W2), where S1 is filter drag, K2 is resistance coefficient, W1 is filter weight, and W2 is cake weight. Data on the character of the dust and the total dust loading from industrial sources are inputs to the equation. The design equation is solved for typical ranges of dust loadings and particle size and typical design limits for commercially available filters to show how initial filter designs can be obtained. Figures are provided which illustrate the quantitative interrelationships between the particle size, dust loading, filter weight, pressure drop, and cleaning interval. Figures of this type, obtained from the design equation, allow rapid initial design decisions and require no calculations. The trade off relationship between pressure drop, weight of filter, and cleaning interval are clearly evident in the figures. (Author abstract)

53991

Sundberg, Ronald E.

THE PREDICTION OF OVERALL COLLECTION EFFICIENCY OF AIR POLLUTION CONTROL DEVICES FROM FRACTIONAL EFFICIENCY CURVES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1973. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-288.)

The prediction of overall collection efficiency from the particle size distribution of the dust and the fractional efficiency of the air pollution control device is described. The cumulative particle size distribution of dust resulting from industrial processes can usually be represented by a straight line on logarithmic probability paper or a log normal function. The fractional efficiency curves of many air pollution control devices such as cyclones or wet scrubbers can also be adequately represented by a log normal function. Only two parameters are required to define a log normal function, a median diameter, and a geometric standard deviation. Both of these can easily be obtained from a plot on logarithmic probability paper. The overall collection efficiency is simply related to the four parameters required to define the log normal functions representing the particle size distribution and the collector fractional efficiency. Using this relationship, the prediction of overall collection efficiency is greatly simplified with no loss of accuracy. (Author abstract modified)

54011

Cowherd, Chatten, Jr. and Kenneth D. Smith

THE CONTROL OF PARTICULATE EMISSIONS FROM ALFALFA DRYERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 27p., 1973. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-304.)

A study was undertaken to evaluate the effectiveness and costs of available techniques for the control of dryer generated particulates which are emitted from primary cyclone collectors. Bench-mark performance data for two pilot scale and three full scale wet collectors (scrubbers) and two full scale systems which recycle effluent from the primary cyclone indicate that medium efficiency wet scrubbers have the potential to bring alfalfa dryer emissions into compliance with the Bay Area emission standard; however, problems of water clarification and sludge remain to be solved. Also, the partial recycling of cyclone effluent back to the dryer furnace holds promise of a significant reduction in particulate emissions. Dryer generated particulate emissions are highly dependent on process conditions, particularly hay quality and dryer production rate (dry basis). The total particulate emission from an alfalfa dehydrating plant, without emission control, averages less than 20 lb/ton of pellets (or meal). Based on cost figures submitted by the control equipment manufacturers, the equipment and installation costs for a wet scrubber and water treatment system range from $33,000 to $45,000 and annual operating costs are about $3000. The installed cost of a recycle system is about $20,000, and a net operating savings of $3000 is realized because of decreased fuel usage. These figures apply to a model control problem which requires a control efficiency of about 80% for an effluent of 30,000 cu ft/min with a particulate loading of 0.30 gr/scf. (Author abstract modified)

04133

Tassicker, Owen J. and Kenneth M. Sullivan

ESTIMATION OF PRECIPITATOR PERFORMANCE FOR COLLECTION OF FLY ASH BY EXAMINATION OF LOW SULPHUR COAL BORE CORES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1973. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-311.)

A method to aid in the sizing of a precipitator for the collection of ash from a new low sulfur coal field by examination of the bore core samples was developed. Such samples are prepared, analyzed, and then fired in a specially developed microfurnace whose combustion dynamics are such as to produce ash resembling full scale boiler fly ash. The ash is subjected to electrical tests including resistivity and corona measurements. The resistivity data are used for ranking the performance of a precipitator treating such ash. It was shown in a parallel study of field tests on pilot precipitators that resistivity correlates significantly with precipitator efficiency. (Author abstract modified)

04331

Huntington, Richard L.

INCINERATOR AFTERBURNER PARTICULATE EMISSION FACTORS: A CORRELATION AND COMBUSTION STUDY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 33p., 1973. 15 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-258.)

An incinerator afterburner emission factor equation was derived based upon chemical reaction rate kinetics. This equation compared favorably with observed emission factor test data and the available literature. The chemical reactions involved in the combustion process and in smoke formation were compared thermodynamically to observed combustion rate constants. Smoke-producing reactions were investigated and indicated that both carbon dioxide and water play an important part in determining the reactivity of primary chamber particulate smoke emissions when burned in the secondary afterburner chamber and in the overall combustion process. The acceleration effect of moisture and CO2 on the combustion process was attributed to the reversible water gas reaction. Both CO2 and water served as oxidizing agents at high temperatures. A combustion reaction phase diagram for the formation and destruction of smoke was prepared and used to establish minimum smoke formation and combustion temperatures. Equivalent minimum combustion zone residence time, excess air and combustion zone temperature combinations are presented in graphic form. (Author abstract)

16048

Friedlander, Sheldon K.

SMALL PARTICLES IN AIR POSE A BIG CONTROL PROBLEM. Environ. Sci. Technol., 7(13):1115-1118, Dec. 1973. 6 refs.

The origin and control of atmospheric particulate matter are discussed. Control of gaseous precursors to aerosol formation (sulfur dioxide, nitrogen oxides, and certain hydrocarbons) is a key factor in the control of total particulates. In developing improved standards for particulate pollution, the chemical nature of the particulates and its relation to particle size should be taken into consideration. On a tonnage basis, the principal industrial sources of particulates include fuel combustion, cement dust, and steel manufacture. Their control depends on proper process design in the planning stages and on the use of gas cleaning devices, primarily electrical precipitators, fabric filters, and wet scrubbers. This equipment is least efficient in removing particles in the critical 0.1 to 1.0 micron size range. Particle removal efficiencies claimed for electrical precipitators are usually in the range 90-99% on a weight basis. There are difficulties associated with stack gas sampling; outlet loadings for the same effluents measured with different sampling trains varied by as much as a factor of four.

17421

Fraser, Malcolm D. and Gary J. Foley

A PREDICTIVE PERFORMANCE MODEL FOR FABRIC FILTER SYSTEMS. I. INTERMITTENTLY CLEANED SINGLE-COMPARTMENT SYSTEMS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 9p., 1974. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974.)

A performance model was developed for a single compartment fabric filter. The model assumes that the filtering layer consisting of dust and fabric can be thought of as a tangled mass of fibers of various diameters. Particle collection results in the growth of fiber-like particle filaments attached to the fibers which then act as filters. The general type of theoretical collection equations for diffusion, interception, and impaction then apply. The model is the first complete computerized model for a fabric filter system. Collection efficiency is described by equations for clean filters and dirty filters. A standard equation is included to describe the pressure drop as a function of time and of two important coefficients -- the effective drag of the fabric after cleaning and the dust-fabric resistance coefficient. The model predictions are compared with limited available data. A set of data for collection of fly ash on a variety of fabrics was used to show that the model can predict the general effect of fabric type on performance.

17700

George, Herman F. and Gary W. Poehlein

CAPTURE OF AEROSOL PARTICLES BY SPHERICAL COLLECTORS: ELECTROSTATIC, INERTIAL, INTERCEP-

TRIC AND VISCOUS EFFECTS. Environ. Sci. Technol., 8(1):60-65, Jan. 1974. 9 refs.

The collection of aerosol particles smaller than 10 micron is important in air pollution control. A mathematical model is presented to predict the efficiency of the capture of aerosol particles by spherical collectors. This model considers inertial, viscous, gravity, and electrostatic forces, and the interception phenomena. The model shows that the efficiency of collection can be improved by the presence of electrostatic charges on the particles. The model, based on potential flow around the collector, is written in dimensionless form. Model predictions are plotted in terms of the appropriate dimensionless groups and are compared with previous works that considered electrostatic and viscous forces separately. (Author abstract modified)

57729

Guthman, B. and C. W. Vogelsang

CONTROL OF PARTICULATE AND SO2 EMISSIONS FROM AN INDUSTRIAL BOILER PLANT. Bldg. Systems Design, 71(1):180-189, Dec./Jan. 1974. (Presented at the American Society of Mechanical Engineers Industrial Power Conference, Louisville, Ky., May 14-26, 1973, Paper 73-IPWR-3.)

Determination of the most economical route to control industrial boiler plant particulate and sulfur dioxide emissions for a specific site requires an in-depth analysis of the factors applicable to that site. The major factors are fuel cost and availability, how they are expected to vary with time, the confidence of the forecast, and the relative technical risk of pollution control alternative selection. Natural gas and No. 2 oil, when gas is not available, is the preferred route as long as current price and availability forecasts hold. The most economic alternative to natural gas and No. 2 oil is 0.7% sulfur-content coal, using either bag filters or electrostatic precipitators, if the fuel price differential between low and high sulfur coal holds as forecasted. Further, SO2 control is entirely dependent upon an assumed 10-year supply of 0.7% S coal. Tail-end limestone flue gas scrubbing offers the greatest potential on an annual operating cost basis. However, investment is high and risk is great as system reliability has not been demonstrated. This should be the preferred route because it makes possible the use of our most abundant fuel resource. However, more demonstrations of technology are required before the investment risk is reasonable. The following program has been adopted to prepare for the time when natural gas is not an available boiler fuel: continue with natural gas and No. 2 oil as long as possible, maintain an on-going program to determine if flue gas scrubbing is practical, and stay intimately familiar with all changes in fuel prices and availability. (Author summary)

59120

Bickelhaupt, Roy E.

ELECTRICAL VOLUME CONDUCTION IN FLY ASH. J. Air Pollution Control Assoc., 24(3):251-255, March 1974. 14 refs.

Resistivity and unsophisticated transference experiments were conducted at temperatures above 300 C. Six commercially produced fly ashes having similar overall chemistry but differing significantly in concentrations of alkali metals and alkaline earths were used. Test specimens were fabricated by pressing and sintering the ash into self-supporting discs. An Arrhenius equation was used to interpret the resistivity-temperature relationship. From the lack of deviation in experimental activation energy among the ashes the same conduction mechanism prevailing in each was shown. The quantity of electricity conducted was proportional to a mass transfer and lithium and sodium ions migrated. Resistivity was inversely proportional to the combined Li and Na concentration. The volume conduction process was controlled by an ionic mechanism in which Li and Na are the principal charge carriers. The overall conduction process involving specimens and electrodes was interpreted using the results of recent fundamental research on silicate glasses. (Author abstract)

59140

Stenhouse, J. I. T.

THE INFLUENCE OF ELECTROSTATIC FORCES IN FIBROUS FILTRATION. Filtration Separation (Purley), 11(1):25-26, Jan./Feb., 1974. 21 refs.

Mathematical expressions are derived for the efficiency of collection of particles in fibrous filters due to an electrostatic mechanism in which either the particle or fiber or both are charged. The theory is based on the cellular model of flow through a filter and is in excellent agreement with published experimental data. An increase in the packing density of a filter has two effects. The streamline tortuosity is increased and causes an increase in collision efficiency due to interception and the fact that the particle is brought close to the fiber where the electrostatic forces are strongest. The electrostatic forces, however, will be effective over a shorter range, causing a reduction in the collision efficiency due to electrostatics. Calculations for the effect of fiber packing density indicate that in the case of charged fibers an increase in fiber packing density will have little or no effect on the single fiber collision efficiency.

59807

Frauenfelder, A.

OVERCOMING SPECIAL PROBLEMS IN ELECTRICAL PRECIPITATION. Filtration Separation (Purley), 11(1):53, 55, 58, Jan./Feb., 1974. (Presented at the Proceedings of the Filtration Society, Filtration Society's Conference on What's New in Dust Control and Air Cleaning at the Dust Control and Air Cleaning Exhibition, London, England, Sept. 25-27, 1973.)

Problems encountered with the operation of electrostatic precipitators are reviewed in relation to the pretreatment of gases, the flow of gases in the precipitator, corrosion, and stress corrosion. Very dry gases and dust with high electrical resistivity require pretreatment such as water injection for favorable recovery. Normally, gas conditioning towers with water nozzles are provided ahead of the precipitator in order to cool the gases to 150-200 C and to raise the water dew point of the gases to 50-55 C. Other conditioning agents such as sulfur trioxide are employed for thermal power station applications. Even distribution of the dust-laden gases over the whole area of the precipitator is of the utmost importance. Model tests are essential if expensive adjustments of the full scale precipitator are to be avoided. Modern precipitator design must also ensure that gases will not bypass the electrical fields. Precipitators are susceptible to corrosion, particularly in the cement industry; thus, the shell of the precipitator is normally built in concrete and the works in acid-resisting materials. Rubber coating is used on the inside of precipitators designed for aluminum finishing processes employing the treatment of aluminum with chlorine gases. Stress corrosion is another problem, and for precipitators sited behind raw mills in cement works where temperatures are rather low, protection by a varnish might be helpful. Other design considerations include a good high tension rectifier, unbreakable discharge electrodes, and optimum plate gap width.

[illegible]

Wagner, A. J. (ed.)

STEAM-POWERED DUST COLLECTORS ATTAIN HIGH EFFICIENCIES ECONOMICALLY. Mod. Casting, 64(2):56-58, Feb. 1974.

An economical and highly efficient steam-powered dust collector has been successfully developed and operated at a steel mill and pipe shop installation. The device uses a high speed steam drive which creates its own draft; the draft draws exhaust gases into a mixing tube where process water is injected. Quick agglomeration is achieved with submicronic particulates, bringing them to manageable size for disposal in low pressure drop cyclones. The system handles particulates from 0-10 micron at efficiencies of more than 99%. A sulfur dioxide removal efficiency of 99.94% can also be achieved with the addition of chemically treated water.

60214

Hull, Andrew P.

COMPARING EFFLUENT RELEASES FROM NUCLEAR AND FOSSIL-FUELED POWER PLANTS. Nucl. News, 17(5):51-55, April 1974. 21 refs.

The effluents from nuclear and fossil-fueled power plants are compared for harm and emission standards. Nuclear boiling water reactors will release 1.66 times 10 to the 6th power gaseous airborne effluents, 1.31 airborne halogens and particulates, 49.6 liquid fission and corrosion products, and 104 Ci/yr liquid tritium effluents. Pressurized water reactors will release 5830, 0.17, 30.0, and 5700 Ci/yr, respectively. Nuclear plants will also emit radioactivity. Coal, oil, and gas fueled power plants emit sulfur dioxide, nitrogen dioxide, carbon monoxide, hydrocarbons, and particulates. If fossil-fueled and nuclear power plants are compared by their compliance with standards, and if air quality standards are given the same significance that the radiation protection standards have been given, then nuclear plants clearly limit over-all air pollution to a greater degree than fossil-fueled plants.

60221

Pilat, Michael J., Steven A. Jaasund, and Leslie E. Sparks

COLLECTION OF AEROSOL PARTICLES BY ELECTROSTATIC DROPLET SPRAY SCRUBBERS. Environ. Sci. Technol., 8(4):360-362, April 1974. 14 refs.

Theoretical calculations and experimental measurements showed that the collection of small aerosol particles (0.05-5 micron diameter) by water droplets in spray scrubbers can be substantially increased by electrostatically charging the droplets and particles to opposite polarity. Measurements with a 180 acfm two-chamber spray scrubber (7 sec gas residence time) showed an increase in the overall particle collection efficiency from 68.8% at uncharged conditions to 93.6% at charged conditions with a dioctyl phthalate aerosol (1.05 micron particle mass mean diameter and 2.59 geometric standard deviation). The collection efficiency for 0.3 micron particles increased from 35% to 87% when charged. (Author abstract)

60131

Statnick, R. M. and D. C. Drehmel

FINE PARTICLE CONTROL USING SULFUR OXIDE SCRUBBERS. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., Control Systems Lab., 33p., 1974. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-231.)

Data were obtained on the fine particle collection efficiency of sulfur oxide scrubbers at two power generating stations. A venturi and a turbulent contacting absorber (TCA) both with capacities of 30,000 cfm were tested at one site, while a venturi with 600,000 acfm capacity was tested at the other site. Fine particle collection efficiency was determined at three pressure drops for the TCA using a cascade impactor. The TCA showed high removal efficiencies, collecting more than 90% of submicron particles when the pressure drop was nearly 10 in. of water. The overall particulate removal in the TCA scrubber as determined by modified method five or by a Brink impactor was greater than 99% when the pressure drop was greater than 8 in. H_2O. Collection efficiency for both venturi scrubbers decreased rapidly with decreasing particle size in the fine particle region. (Author abstract modified)

61754

Carroll, J. J., J. R. Dunbar, R. L. Givens, and W. B. Goddard

SPRINKLING FOR DUST SUPPRESSION IN A CATTLE FEEDLOT. Calif. Agr., 28(3):12-14, March 1974.

The effectiveness of sprinkling open, unpaved, feedlot cattle pens for dust control, and the effect of sprinkling on the temperature and relative humidity were investigated. The air temperature, humidity, and dustiness were measured simultaneously at several locations within two lots, one of which was sprinkled. Data recording was begun on June 23, 1970 and was terminated on Sept. 9, 1970. The data consisted of 15 min samples taken once each hr, 24 hr per day. The results show that sprinkling lots during the first 8 week clearly reduced dustiness by about one-half. During the period following rain, the dustiness of the unsprinkled lot was also reduced by at least half. The maximum temperature reached within the sprinkled lot was reduced by 5-10 F, the relative humidity increased by about 10%. This suggests that sprinkling has no significant effect on the evaporative cooling of the animals.

61776

White, Harry J.

RESISTIVITY PROBLEMS IN ELECTROSTATIC PRECIPITATION. J. Air Pollution Control Assoc., 24(4):314-338, April 1974. 51 refs.

High resistivity particles are one of the most common causes of poor precipitator performance. A coherent up-to-date account is given of the problems of high resistivity particles and the basic methods for dealing with them. Historical background, measurement of resistivity by the point plane and concentric-cylinder methods, field and laboratory resistivity data, conduction mechanisms, surface conduction, back corona, sparkover, current-voltage disturbances, effects with positive corona, effects of high resistivity on precipitator performance (electric operation, particle charging, and particle collection), and methods for overcoming high resistivity (clean electrode methods, electrical energization methods, conditioning methods, systems methods, wet methods, temperature-controlled electrodes, and graded-resistance electrodes) are discussed. Both theory and practice show that precipitator design should be coordinated with particle resistivity conditions in order to obtain expected efficiency. Where this has not received adequate attention, precipitator efficiencies as low as 80 to 70% occur instead of design values of 99 to 99+%. Resistivity should be measured in present plants where high resistivity is suspected as a problem, and new plants should be designed to eliminate this problem. Control methods include conditioning with moisture and/or certain chemicals, improving electrical energization of the precipitator, changing precipitator operating temperature to a more favorable zone, changes in raw materials used in the process, correcting gas flow problems if such exist, and using larger size precipitators. In some cases, wet collection may be the method of choice in obviating high resistivity problems.

63181

Rice, Russell W.

DUST CONTROL BASICS. Feedstuffs, 46(10):44-45, March 11, 1974. (Presented at the Oregon Feed, Seed, and Suppliers Association 1974 meeting, Portland.)

The problems of dust collection in a dust control system are discussed. Dust control consists of preventing the fine particles from escaping out of a machine enclosure or system into the work areas and into the atmosphere. The emphasis is on better enclosures to contain dust, on tight spouting, and on conveyors that operate slowly enough to eliminate fine particles from the surrounding atmosphere. Due to environmental concern, the dust collector is of prime importance in a dust control system. The cyclone type separator when properly sized and designed has a lot of favorable characteristics. However, the system can be operated with stack outlet choked down and all dust blowing to the atmosphere. This has caused the environmentalists to arbitrarily rule most systems using cyclone type collectors for removal of fine dust particles as in violation of the standards. The problem is being solved by the installation of cloth filter collectors, either as secondary collectors following the primary cyclones or as the primary collector. The primary cyclone should be used to eliminate 98+% of the dust in the system and return this dust back to the system. The air and 1% of the dust can then be directed to the filter for final cleaning and releasing back to the building or to the atmosphere.

63930

Sparks, L. E.

EFFECT OF WATER VAPOR CONDENSATION ON PARTICLE COLLECTION BY SCRUBBERS. Preprint, U.S.-U.S.S.R. Working Group on Stationary Source Air Pollution Control Technology, 34p., 1974. 51 refs. (Presented at the Symposium on Control of Fine Particulate Emissions from Industrial Sources, San Francisco, Calif., Jan. 15-18, 1974.)

Water vapor condensation can be used to improve particulate collection by scrubbers. The improved particulate collection is due to diffusiophoresis and/or particle growth. Scrubbers which utilize condensation are defined as condensation scrubbers. The literature on condensation scrubbing is reviewed. Selected references are given on Flux Force/Condensation Scrubbers. The results of recent Environmental Protection Agency sponsored research on condensation scrubbing are presented. These results show that the particle collection efficiency of a condensation scrubber is a function of the amount of water vapor condensed. The costs of condensation scrubbing are compared with the costs of high energy scrubbing. The comparison indicates that condensation scrubbing is economically feasible for many applications. (Author abstract modified)

63059

Stock, D. E. and C. T. Crowe

THE EFFECT OF ELECTRODYNAMIC SECONDARY FLOW ON THE PERFORMANCE OF ELECTROSTATIC PRECIPITATORS. Preprint, 14p., 1974. 7 refs. (Presented at the Heat Transfer and Fluid Mechanics Institute, 24th, Corvallis, Oreg., June 12-14, 1974.)

A solution is presented which predicts the flow field for a two-dimensional particle-laden flow found in electrostatic precipitators. The effect of gas-particle and ion-gas momentum coupling is incorporated in the general development. The effect of particle and ion space charge is included in the electric field. The solution is used to analyze the turbulent gas-particle flow in a concentric electrostatic precipitator. The effect of electrodynamic secondary flow (electric wind) and the gas-particle momentum coupling have about the same magnitude and are opposite in direction. The numerical scheme was applied to a wire and pipe precipitator in a laboratory. The same scheme is directly applicable to a wire and plate precipitator, and such a configuration could show a much larger electric wind. The method can be extended to account for particle reentrainment and other conditions. (Author abstract modified)

63078

Epstein, Michael, Louis Sybert, Shih-Chung Wang, and Charles C. Leivo

EPA ALKALI SCRUBBING TEST FACILITY: LIMESTONE WET SCRUBBING TEST RESULTS. Bechtel Corp., San Francisco, Calif., Environmental Protection Agency Contract PH 22-68-67, Program Element 1AB013, Rept. ROAP 21ACY-21, EPA-650/2-74-010, 240p., Jan. 1974. 3 refs. NTIS: PB 232589/AS

Test results are reported for a prototype lime/limestone scrubbing test facility for removing sulfur dioxide and particulates from flue gases. The facility consists of three parallel scrubbers: a venturi/spray tower, a Turbulent Contact Absorber, and a marble-bed scrubber. Each is able to treat a 10 Mw equivalent of flue gas from a coal-fired boiler at the Tennessee Valley Authority's Shawnee station. The report covers more than 1000 hrs of a long-term lime run on the TCA and more than 2000 hrs of a long-term run on the venturi/spray tower system. The objective of testing has been to identify the most economically attractive lime/limestone system operating conditions which are consistent with reasonable performance.

63111

Mockridge, P. C. and D. W. McDowell, Jr.

MATERIALS AND CORROSION PROBLEMS IN A FLY ASH SCRUBBING SYSTEM. Mater. Performance, 13(4):13-17, April 1974. 1 ref.

Corrosion in power plant scrubbing systems is caused by changes in the environment, improper materials and/or protective coatings, or unusual mechanical problems. Since the corrosive medium is principally weak sulfuric acid, high chloride content becomes an important factor, accelerating corrosion. Results of in-service tests of materials for scrubbing are discussed. The tests were conducted on a number of scrubbers designed for fly ash and/or sulfur dioxide removal. The adjustable venturi, the primary mist eliminator, the recycle pumps, the wet ID fans, the secondary mist eliminator, the reheat area, and the stacks are subject to corrosion under some conditions; therefore corrosion-resistant materials should be used. The results of two coated test spool tests showed the need for a protective coating. (Author abstract modified)

63361

Crook, James D.

FUGITIVE DUST CONTROL. Pit Quarry, 66(12):67-68, 106-107, June 1974. (Presented at the National Crushed Stone Association Annual Convention, 57th, McCormick Place, Chicago, Ill.)

Causes and controls of fugitive dusts are reviewed for the quarrying industry. Major causes and contributing factors of fugitive dusts include: weather elements such as wind velocity and direction, precipitation, and moisture; quarry operations such as drilling, blasting, loading, haul units and roads, and stockpiles; non-vegetated or bare areas; and land configuration both in and surrounding plant stockpile areas. Control measures include: water spraying, scheduling blasting during periods of either low wind or the correct wind direction, the use of stone ladders (enclosed towers) to eliminate the long free-fall of stone, the mixing of sand and water in a small pug mill, the use of stacker conveyors which can be raised or lowered just above the pile, and proper location of stockpiles.

64811

Morris, G. B. and J. L. Schumann

CONDITION FLYASH WITH SYNTHETIC SO_3. Power, 118(7):60-61, July 1974. 13 refs.

The conditioning of fly ash with synthetic sulfur trioxide is discussed. It enables an electrostatic precipitator to achieve normal collection efficiencies when cleaning flue gas at temperatures within the difficult range of 240-350 F and from boilers burning low sulfur, high ash coals. The injection of minute quantities of SO_3 reduces the electrical resistivity of the fly ash to values below the critical level of 10 to the 10th power ohms/cm. These SO_3 quantities range from 10 to 30 ppm by volume of the flue gas. On site synthesis eliminates the need for storing or handling either sulfuric acid or liquid SO_3. It is more economical than installing new hot precipitators, wet scrubbers, or special low temperature electrostatic precipitators designed for low sulfur coal. Existing plants can upgrade the collection efficiency of their electrostatic precipitators to meet new particulate codes while continuing to burn economical low sulfur coal.

61336

Dunbar, David R., Kenneth Axetell, Jr., and George A. Jutze

CONTROL TECHNIQUES FOR PARTICULATE EMISSIONS FROM UNPAVED ROADS, AGRICULTURAL ACTIVITIES AND CONSTRUCTION. Preprint, Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-93.)

Methods of controlling fugitive dust from unpaved roads, agricultural activities, and construction are presented. All controls are applications of one of three basic techniques: watering, chemical stabilization, or reduction of surface wind speed across exposed sources. Four methods of roadway treatment are used: paving, surface treatment with penetration chemicals, soil stabilization chemicals worked into the roadbed, and watering. Cost considerations are key factors in determining which techniques to use. Methods for control of fugitive dust from agricultural lands are basically the same as those for conservation of topsoils. Six general control methods are: continuous cropping, stubble or other crop residue or mulch left on field, limited irrigation of fallow fields, inter-row plantings of grain between widely-spaced row crops or strip cropping, vegetative or physical windbreaks, and spray-on chemical soil stabilizers. On construction sites, watering has a short effectiveness. Chemical stabilization is not successful in active construction conditions, but is effective after the site is completed. Methods are presented for stabilization of waste tailings to prevent air and water pollution, suppression of dust for storage piles, and dust control from cattle feedlots. Many of the methods described, particularly for agricultural sources, have a relatively low percentage control and may not be capable of achieving necessary reductions. If these individual measures are combined into an overall soil management program, they will have a synergistic, rather than a purely additive effect. While the costs for control are not unreasonable for a particulate source, the costs on a regional basis could easily exceed those for conventional stationary sources, especially for large agricultural areas. There is a need to begin to develop a program within the air pollution control agencies to control those sources of fugitive dust which have a significant impact upon the air quality within their jurisdiction.

61239

Adams, Richard L.

FABRIC FILTERS FOR CONTROL OF POWER PLANT EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1974. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-100.)

Four separate pilot units were used in the application of fabric filters to coal-fired utility boilers. A fabric filter equipped with fiberglass fabric at an air-to-cloth ratio of approximately 3.5 to 1 resulted in a pressure drop in the range of 4 in. w.g., when handling the effluent from coal-fired boilers. Cloth cleaning is by a combination of mechanical shake plus deflation. The operating results from the first installation confirm pilot studies, and design parameters for another unit to be installed at a major Eastern utility are presented. Cost comparisons with an electrostatic precipitator on a 1000 megawatt station show that the fabric filter represents a significant reduction in capital costs on coals having a sulfur content of less than 1.0% where precipitator efficiency is required to be at least 99.5%. Basic design criteria are presented that represent the minimum design requirements for a unit to be installed on a large coal-fired utility boiler. The performance of these units can exceed that of electrostatic precipitators on many major utility installations in the United States. (Author abstract modified)

61240

Janoso, Richard P.

BAGHOUSE DUST COLLECTORS ON A LOW SULFUR COAL FIRED UTILITY BOILER. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1974. 4 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-101.)

The baghouse dust collectors installed to reduce fly ash emissions from low sulfur, anthracite coal-fired Units 1 and 2 of the Sunbury Steam Electric Station, Pennsylvania Power and Light Company are evaluated. Each boiler is rated at 80 MW. The bag filters have performed well after over a year of operation, although there is evidence of bag wear due to bag life considerations. There were no serious problems which affected boiler reliability. Problems encountered have been associated primarily with auxiliary equipment, and not with the baghouses themselves. The installation cost for the baghouses including the fly ash removal system was approximately $1,500,000. In the summer of 1973, the baghouses were tested for particulate and sulfur oxide emissions performance by the Environmental Protection Agency and results were within applicable Commonwealth of Pennsylvania regulations. Particulate emissions met the manufacturer's guarantee of greater than 99% removal efficiency. (Author abstract modified)

61262

Reynolds, Joseph P., Louis Theodore, James Marino, and Luigi Di Francesco

THE GENERATION OF PERFORMANCE CURVES FOR ELECTROSTATIC PRECIPITATORS THROUGH THE USE OF A NEW TECHNIQUE FOR CALCULATING COLLEC-

TOR EFFICIENCIES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 38p., 1974. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-137.)

A model for calculating collection efficiencies was used to generate performance curves for 12 industries presently using electrostatic precipitators. These industries include the electric power, cement, pulp and paper, steel, chemical, and petroleum industries. The performance curves describe the predicted collection efficiency as a function of precipitator length, plate-to-plate spacing and average field strength, and are presented in graphical, tabular, and equation form. Whenever literature values are available for a particular industry, comparisons are made between the collection efficiencies generated by the new model and those based on actual precipitator performance. The collection efficiency in the new model is sensitive to particle size distribution, a complication that cannot be treated in the Deutsch Anderson equation which permits the use of a single representative particle size only. (Author abstract modified)

63261

First, Melvin W. and William C. Hinds

HIGH EFFICIENCY REMOVAL OF SUBMICRON PARTICLES BY ULTRA-HIGH VELOCITY AEROSOL FILTRATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 38p., 1974. 19 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-139.)

The high efficiency removal of submicron particles by ultra-high velocity aerosol filtration was investigated. Collection efficiency of fibrous filters for submicron aerosol particles decreases as face velocity increases above the customary range of 5-30 fpm. For velocities greatly in excess of a few hundred ft/min, collection efficiency increases spectacularly and soon attains values in excess of 99% for 0.7 micron dioctyl phthalate (DOP). These high efficiencies persist to 1500 fpm. Energy requirements increase to levels comparable to those needed for successful operation of high energy scrubbers. The advantages of ultra-high velocity include: compactness of equipment with opportunities for significant reductions in acquisition and installation costs; collection efficiency high enough to meet modern emission control regulations; a dry collection method that requires no water supply or disposal facility. Commercial applications of high velocity filtration to control plastic curing oven fumes were effective in eliminating the characteristic white plume caused by condensing plasticizer. (Author abstract modified)

63375

Shannon, L. J.

CONTROL TECHNOLOGY FOR FINE PARTICULATE EMISSIONS (FINAL REPORT). Midwest Research Inst., Kansas City, Mo., Environmental Protection Agency Grant R-801615, ROAP No. 1AB012-03, Program Element 1AB012, Rept. EPA-650/2-74-027, 228p., May 1974. 186 refs.

Results are presented from a study to assess the state-of-the-art of control technology for fine particulates emitted from stationary sources, with emphasis on the control of primary particulates. Topics covered include: particle collection and agglomeration mechanisms; conventional control equipment which includes electrostatic precipitators, fabric filters, and wet scrubbers; emerging control systems such as the steam-hydro air cleaning system, the ADTEC wet scrubber, and the wetted-knit mesh filter; proposed control systems including condensation scrubbers, charged droplet scrubbers, foam scrubbers, electrified filters, granular bed filters, fluidized beds, gamma-ray precipitators, and sonic agglomerators; and recommendations for research and development programs.

63630

Dean, K. C., Richard Havens, and M. W. Glantz

METHODS AND COSTS FOR STABILIZING FINE-SIZED MINERAL WASTES. Bureau of Mines, Salt Lake City, Utah, Salt Lake City Metallurgy Research Center, Rept. of Investigations 7896, 26p., 1974. 6 refs.

Field and laboratory tests of stabilizing fine-sized mineral wastes, and the methods and costs for stabilizing wastes are reviewed. Fine-sized mineral wastes discarded by ore milling plants require stabilization to prevent air and water pollution. Stabilization can be attained by physical, chemical, vegetative, and combination procedures. Vegetative reclamation is preferred to physical and chemical stabilization, but is difficult to achieve because the wastes are sterile, contain deleterious inorganic salts, and lack the essential nutrients and physical characteristics required for sustaining vegetative growth. Methods now have been developed to attain vegetative growth on all but excessively acidic, basic, or saline tailings at costs ranging from 120 to 650 dollars/acre. The cost for stabilizing tailings requiring more intensive treatment techniques may range upward to $1750/acre. Procedures developed by the Bureau of Mines and industry for vegetating amenable tailings are described. Costs for the various processes are listed, and procedures that may be applicable for stabilizing saline and pyrite-containing tailings are suggested. Ridged planting beds, drip irrigation, and deep-furrow planting techniques are suggested for stabilizing saline wastes. A combination of mill tailings and sewage sludge can be used for producing synthetic soils, and layers of sewage sludge buried under a layer of tailings offer promise of inhibiting acid formation from oxidation of sulfides in mineral wastes. Pelletization of tailings to improve physical structure is beneficial in establishing a vegetative cover. Nitrogen fertilization maintenance costs for vegetatively stabilized tailings can be reduced by use of nitrogen-fixing native plant species such as Indian ricegrass. Microvegetative growth can be achieved on tailings and offers promise over macroscopic forms on tailings in arid regions, but the algae, lichens, and mosses are as subject to salinity stresses as the larger plant species. (Author abstract modified)

63901

Guida, Kent

THE USES OF FLY ASH IN A FERROCEMENT MIX DESIGN. Bureau of Mines Information Circ., no. [illegible], 1974. 4 refs. (Presented at the International Ash Utilization Symposium, 3rd, Pittsburgh, Pa., March 13-14, 1973.)

The uses of fly ash in ferrocement are discussed. Ferrocement is a reinforced concrete material which has a high degree of imperviousness and elasticity, excellent resistance to crack propagation, and high strength-weight ratio. Ferrocement mix designs are based on obtaining the highest possible compressive strength and maximum workability. Fly ash addition to ferrocement can produce a lubricating effect which improves workability, penetrability, and ease of finishing, pozzolanic action to give long-term increase in strength, increased sulfate resistance, and inhibition of corrosion of steel when stimulated hydraulically by the lime from the hydration of cement. These effects are described.

[illegible]

Mielenz, Richard C.

SPECIFICATIONS AND METHODS OF USING FLY ASH IN PORTLAND CEMENT CONCRETE. Bureau of Mines Information Circ., no. 8640:61-74, 1974. 27 refs. (Presented at the International Ash Utilization Symposium, 3rd, Pittsburgh, Pa., March 13-14, 1973.)

Fly ash is utilized in three general ways in the preparation of portland cement mixtures: As an admixture in concrete or mortar, as a pozzolan component of a blended hydraulic cement, and as a portion of the raw material used in the manufacture of portland cement. The rate of fly ash utilization in portland cement mixtures has increased over the years and can be expected to increase. The three ways of using fly ash are discussed along with specifications for fly ash (both chemical and physical requirements) in these mixtures. Fly ash and bottom ash represent a valuable source of material for use in manufacture of portland cement concrete, portland-pozzolan cement, and portland cement itself. Satisfactory and uniform results can be obtained by development and use of suitable specifications and quality control and quality assurance procedures in the production of the cement and concrete. The diversity of sources of fly ash in terms of types of coal, use of additives to the coal to accommodate air pollution standards, and variable conditions of operation of individual coal-burning facilities present problems in the promulgation of specifications and standards for use of the ash. In some instances, acceptance of the ash and decision on the manner of its use in portland cement concrete must be based upon tests of concrete mixtures proposed for use in specific work. (Author conclusions modified)

[illegible]

Fishman, B. D. and M. E. Valov

REDUCING THE CONTAMINATION OF THE AIR BY DUST AND GASES IN THE MANUFACTURE OF METAL POWDERS FROM MELTS. Soviet Powder Metallurgy and Metal Ceramics (English translation from Russian of: Poroshk. Metall.), 13(4):333-335, April 1974. 3 refs.

The control of dust and gaseous pollutants produced in the manufacture of metal powders from melts is discussed. Escaping pollutants vary greatly in temperature, chemical composition, and particle size. Parts of existing ventilating and dust fume extraction systems were modified in a plant and some new units were provided. The dry screening process which produced an exceptionally large amount of dust (115 mg/cu m) was altogether eliminated. Dust was reduced from the melting furnace from 11.3 mg/cu m to 2.4 mg/cu m, from the on bridge crane level from 18 mg/cu m to 9.3 mg/cu m, and from the drying furnace from 131 mg/cu m to 10.0 mg/cu m. The carbon monoxide concentration was reduced from 0.031 mg/l to 0.012 in the melting furnace, from 0.037 to 0.018 in the on bridge crane level, and from 0.038 to 0.008 in the drying furnace.

[illegible]

McKenna, John D.

APPLYING FABRIC FILTRATION TO COAL FIRED INDUSTRIAL BOILERS (A PRELIMINARY PILOT SCALE INVESTIGATION). (FINAL REPORT). Enviro-Systems and Research, Inc., Roanoke, Va., Environmental Protection Agency Contract 68-02-1093, Program Element 1AB012, EPA-650/2-74-058, ROAP 21ADJ-030, 89p., July 1974. 8 refs.

The techno-economic feasibility of applying a fabric filter dust collector to coal-fired industrial boilers was investigated on a pilot scale. Overall efficiencies greater than 99.5% were achieved with Nomex felt at an air to cloth (A/C) ratio of six to one. Cleaning improved with increasing volumes of reverse air. Both woven Teflon and Gore-Tex on Nomex backing had better release properties than Nomex felt. Installed costs for filter media and electrostatic precipitation at three levels of efficiency are included. Based on 25% bag replacement per yr and an electrostatic precipitator efficiency level of 98%, Nomex felt and Gore-Tex on Nomex backing are competitive with an electrostatic precipitator at A/C greater than 4/1. Teflon felt needs and A/C greater than 7/1 before it becomes competitive. (Author abstract modified)

67817

Environmental Protection Agency, Research Triangle Park, N. C., Control Systems Lab.

SEMINAR ON ELECTROSTATICS AND FINE PARTICLES — SEPTEMBER, 1973. Program Element 1AB012, ROAP No. 21ADL-034, Rept. EPA-650/2-74-081, 133p., Aug. 1974. NTIS: PB 236976/AS

Papers are presented from a seminar on the application of electrostatics to fine particle control. Topics covered in the seminar include: the investigation of systems of charged particles and electric fields for the removal of submicron particulates, the application of charged droplet scrubbing to fine particle control, wet electrostatic collection of fine particles, electrostatic capture of particles in fiber beds, electrostatic precipitator performance, the dust layer and precipitator efficiency, the fractional efficiency of electrostatic precipitators, electric arc generation of metal aerosols in quantity, and new concepts and novel devices for fine particulate control. The last topic is covered in an open pan discussion.

67812

Nekervis, R., J. Pilcher, J. Varga, Jr., H. Elmore, and J. Hallowell

PROCESS MODIFICATIONS FOR CONTROL OF PARTICULATE EMISSIONS FROM STATIONARY COMBUSTION, INCINERATION, AND METALS (FINAL REPORT). Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Environmental Protection Agency Contract 68-02-1323, Task 8, ROAP No. 21ADE-017, Program Element 1AB012, Rept. EPA-650/2-74-100, 116p., Oct. 1974. 107 refs. NTIS: PB 237489/AS

The state of process modifications for controlling fine particulate emissions from stationary combustion sources (electric utilities and industrial processes), municipal incinerators, iron and steel plants, ferro-alloy plants, and nonferrous metal smelters (zinc plants, copper smelters, and aluminum reduction cells) is reviewed. Modifications to conventional stationary combustion sources considered include: ash fluxing, sulfur trioxide addition to flue gas, staged combustion, the use of fuel additives, fly ash agglomeration, solvent refining, and flue gas recirculation. Unconventional systems studied include: fluidized beds, coal gasification, and submerged combustion. Combined flue-refuse firing, gas cooling, and pyrolysis methods are considered for incinerators. Emphasis for iron and steel plants is given to the bottom-blowing oxygen process. Modification of the conventional reverberatory smelting procedure and the introduction of hydrometallurgical methods are discussed for copper. The chloride electrolytic process by the Aluminum Company of America is considered for aluminum. Each process is considered with respect to its stage of development, availability or acceptability by industry, efficiency in reducing emissions, and environmental impact. (Author abstract modified)

[illegible]

Walker, Alan B.

EXPERIENCE WITH HOT ELECTROSTATIC PRECIPITATORS FOR FLY ASH COLLECTION IN ELECTRIC UTILITIES. Combustion, 46(5):[illegible], Nov. 1974. 10 refs.

Operating experience with over 30 fly ash precipitators on utility steam generating units, ranging in size from 30 MW to 1000 MW, is described. Operating temperatures on these units ranged from 630 to over 900 F; operating service ranged from 3 to 18 months. Approximately 60 full-scale performance tests were run on 19 different steam generating units in 11 different plants. Actual performance data on all commercial scale installations tested to date are presented. A specific collecting area in the range of 180 to 301 sq ft/1000 acfm will achieve 99% removal and specific collecting areas of 230 and 400 are required for 99.8% removal. Power density effects and physical reliability aspects of the precipitators are reviewed. From a high efficiency standpoint, hot-type precipitators are highly reliable and can be designed with a much higher degree of certainty than cold precipitators because the probability of encountering high resistivity operating conditions is sharply reduced. Structural and mechanical design of hot precipitators requires careful attention to designs which minimize temperature gradients and allow for differential thermal expansion where such temperature gradients cannot be avoided. Hot-type precipitators have an economic advantage over cold-end units under situations where the cold-end units must be designed for operation under high resistivity ash conditions. Hot-type precipitators appear to have a performance reliability advantage over cold precipitators in high resistivity situations. (Author conclusions modified)

[illegible]

Hudson, J. A. and Joseph Green

POLLUTION, PRECIPITATORS, PROBLEMS, AND PLANS (TVA'S PARTICULATE EMISSION COMPLIANCE PROGRAM). Combustion, 46(4):11-[illegible], Oct. 1974. (Presented at the American Power Conference, Annual Meeting, 36th, Chicago, Ill., April 29-May 1, 1974.)

The Tennessee Valley Authority's particulate emission compliance program involving the use of electrostatic precipitators to reduce fly ash from coal-burning steam generation plants is described. A total of 111 precipitators will have been built for generating units ranging in size from 60-1300 mw and designed for coal with sulfur ranging from 0.7-4.0% over the program period 1958-1977. The cost per kilowatt for such installations is estimated to vary from 1-47 dollars, depending on the time of installation, the efficiency required, the amount of sulfur in coal being burned, and requirements for modifications and additions such as new chimneys and fans. Data concerning the number of units, the number of precipitators, the percent efficiency specified, the capacity the installed units, gas temperature and velocity, percent sulfur in coal burned, percent fly ash, starting and completion dates for installation, plant capacity, installed cost, and cost per kilowatt are tabulated for various plants where precipitators were installed during original plant construction or as part of retrofit programs. Specified efficiencies vary from 95-99.6%.

[illegible]

Cavin, Daniel C.

A STUDY OF IRON AND ALUMINUM RECOVERY FROM POWER PLANT FLY ASH. Iowa State Univ., Ames, Ames Lab., Atomic Energy Commission Contract W-7405-eng-82, Rept. IS-T-611, 131p., April 1974. 70 refs. NTIS: IS-T-611

A study of iron and aluminum recovery from power plant fly ash was performed to characterize a particular fly ash as a potential source of iron and aluminum. Magnetic separation of the iron-rich particles provided a fly ash fraction amenable to further iron extraction processes. Sulfuric acid leaching of the whole sample of fly ash as well as the fines (minus 300 mesh) showed a decrease in aluminum extractibility at increasing acid strengths. Lime sintering of the nonmagnetic fines revealed an increase in aluminum extractability at higher mole ratios of calcium oxide to aluminum oxide. The primary crystalline aluminum bearing mineral in the fly ash sample studied was mullite, with trace quantities of calcium aluminates also being observed. In comparison to aluminum recovery from clays and other aluminous materials, fly ash is much more refractory in nature. Preliminary roasting of fly ash prior to sulfuric acid leaching reduced the aluminum extractability by reinforcing the refractory character of the ash. (Author abstract modified)

[illegible]

Bickelhaupt, R. E.

SODIUM CONDITIONING TO REDUCE FLY ASH RESISTIVITY. Southern Research Inst., Birmingham, Ala., Environmental Protection Agency Contract 68-02-0284, ROAP 21ADJ-029, Program Element 1AB013, Rept. EPA-650/2-74-092, 14p., Oct. 1974. 8 refs. NTIS: PB 238033/AS

Results from a review of recent research and two field tests at power stations are presented on the use of sodium conditioning to reduce fly ash resistivity for efficient collection by electrostatic precipitation. The two field tests were conducted at operational temperatures between 140 and 175 C, the range in which surface conduction should dominate, were both technically successful in that the resistivity was reduced by the predicted amount following the addition of sodium. Neither of the two facilities were using sodium conditioning. Potential compounds that can be considered as sources of sodium oxide conditioning agents include: sodium carbonate, sodium sulfate, sodium hydroxide, and sodium nitrate. The source of sodium should be uniformly distributed throughout all of the coal feed to insure that the sodium becomes an integral part of all the ash. A procedure is given for calculating the amount of sodium that must be added to reduce fly ash electrical resistivity to a desired value. Advantages of sodium conditioning include small capital investment, low labor cost for operation and maintenance, no material handling problems and facile adjustment of the amount of source material to compensate for sodium level changes of incoming coal. Disadvantages are source material cost and potential boiler fouling.

[illegible]

Seale, Leonard M. (ed.)

PROCEEDINGS: SYMPOSIUM ON THE USE OF FABRIC FILTERS FOR THE CONTROL OF SUBMICRON PARTICULATES (APRIL 8-10, 1974, BOSTON, MASSACHUSETTS). GCA Technology Div., Bedford, Mass., Environmental Protection Agency Contract 68-02-[illegible], Program Element 1AB012, ROAP 21ADJ-[illegible], Rept. EPA-650/2-74-043, [illegible]p., May 1974. [illegible] refs. NTIS: PB 237670/AS

Proceedings presentations are given from a symposium aimed at describing the fine particulate control potential of existing fabric filter systems for the benefit of regulatory and user groups and suggesting to manufacturing and research organizations those areas where performance levels most need improvement. Topics covered include: the significance of particulate emissions; emission standards for particulates; performance and cost comparisons between fabric filters and alternate particulate control techniques; types of fabric filter installations; comparison of fine particle capture in filter structures and filter cakes; optimizing filtration parameters; engineering and economic considerations in fabric filtration; collection efficiency as a function of particle size, shape, and density; some effects of electrostatic charges in fabric filtration; the design of a filter system to meet specified efficiency and emission levels; laboratory generation of particulates with emphasis on sub-micron aerosols; methods for determining particulate mass and size properties; a mobile fabric filter system; extending fabric filter capabilities; new fabrics and their potential application; new kinds of fabric filtration devices; and needed research in fabric filtration.

[illegible]

Nichols, Grady B. and John P. Gooch

AN ELECTROSTATIC PRECIPITATOR PERFORMANCE MODEL (FINAL REPORT). Southern Research Inst., Birmingham, Ala., Environmental Protection Agency Contract EPA 70-166, Program Element 1AB012, Rept. EPA-650/2-74-132, ROAP 21ADJ-026, SORI-EAS-74-444, 180p., July 1974, 87 refs. NTIS: PB 236922/AS

An electrostatic precipitator performance model was developed and critical factors limiting precipitator performance were analyzed. Quantitative relationships were established between precipitator performance and these factors. Operating experience and costs were reviewed to determine the influence of gas temperature on overall system economics and problems related to the tendency toward corrosion and fouling of the air heater and precipitator. A small-scale precipitator was designed and constructed to study precipitator fundamentals such as the effect of changing time, relation of particle distribution in the interelectrode space to collection efficiency and reentrainment factors. Measurements were made at several power stations burning different types of coal to compare resistivities measured by several types of apparatus and to provide data for analysis of precipitator performance.

70881

Soderberg, Henning F.

ENVIRONMENTAL, ENERGY AND ECONOMIC CONSIDERATIONS IN PARTICULATE CONTROL. Mining Congr. J., 60(12):24-29, Dec. 1974.

The costs of clean air are discussed with respect to the coal industry. Because of the high operating costs of air pollution control equipment, and energy and environmental systems, choice of control methods is very important in the coal industry. Several types of dust control equipment and their performance, costs, and power requirements are reviewed. Cyclone efficiency as a function of particle size, cloth collectors, thermal dryer pollution problems, venturi scrubbers, ways of improving collection efficiency, effects of dust loads and distributions on collection, and wet scrubbers as the practical solution for coal dryer emissions are discussed.

70810

Monroe, E. S.

THE CYCLONIC INCINERATOR. Preprint, du Pont de Nemours (E. I.) and Co., Inc., Wilmington, Del., 13p., 1974 (?).

The development of a cyclonic incinerator is described through its three stages, starting with the open pit. Rectangular cyclonic incinerators, cyclonic incinerators, and single versus multichamber construction are also discussed. Test data are given showing the completeness of combustion. The continued acceptance of the open pit incinerator and the development of the enclosed cyclonic incinerator demonstrate the advantages of the good combustion characteristics inherent in the design. The ability to handle high vaporization loads such as aqueous wastes with simple injectors and without impingement is a decided advantage over the vortex type burner with its higher heat release. Automation can be applied to both types for optimum control of firing rates and temperature control. The cylindrical cyclonic unit provides primary separation of particulate matter in the furnace and potentially reduces the number of applications requiring scrubbers. (Author abstract modified)

71015

Dennis, Richard

COLLECTION EFFICIENCY AS A FUNCTION OF PARTICLE SIZE, SHAPE AND DENSITY: THEORY AND EXPERIENCE. J. Air Pollution Control Assoc., 24(12):1156-1163, Dec. 1974. 13 refs.

The performance features of both industrial and experimental fabric filter systems are analyzed with respect to dust properties (particle size, shape, and density), fabric properties, and methods of filter cleaning. Fractional particle efficiencies in the 0.05-0.5 micron range are not strongly size dependent. Efficiencies generally vary from 85-99.9%, depending on the weight and size distribution of the dust deposited on the filters. High level particulate removal cannot be expected if the fabric possesses a high free area, and outlet concentrations increase rapidly when the fabric pore diameter is about 10 times the particle diameter. Test results from evaluations of various fabric filter cleaning systems with several dust/fabric combinations and various fabric cleaning procedures indicate the following sources of particulate emissions from fabric filters: small-sized inlet dust that passes directly through the filter, dust that migrates through the filter by successive deposition and reentrainment under the combined effects of aerodynamic and mechanical (vibrational) forces, dust dislodged from the shaken fabric during cleaning that has penetrated the clean air region, and dust loosened during cleaning as a result of insufficient bonding to the fibers or interstitial dust structure to resist the dislodging forces.

71074

Accortt, J. I., A. L. Plumley, and J. R. Martin

FINE PARTICULATE REMOVAL AND SO_2 ABSORPTION WITH A TWO-STAGE WET SCRUBBER. Environmental Protection Agency, Research Triangle Park, N.C., Control Systems Lab. and A.P.T., Inc., Riverside, Calif., Fine Part. Scrubber Symp., San Diego, Calif., 1974, EPA-650/2-74-112, p. 144-166. 13 refs. (May 28-29.) (Complete proceedings processed under APTIC 70882.) NTIS: PB 238138/AS

Results from pilot plant studies and early field demonstration studies of a limestone wet scrubbing process designed to remove fine particulates and sulfur dioxide generated from the burning of low sulfur sub-bituminous coal are presented. Based on data obtained from the prototype unit handling 17,000 CFM of gas with an inlet dust loading averaging [illegible] gr/SCF and a particle size distribution showing a substantial amount of fines (smaller than 1.5 micron), the limestone marble bed scrubber collected only [illegible] of the total dust generated by the thermal power unit. With the addition of a first stage collection device (gas atomizing type collector), overall removal efficiency was increased to as high as 99.8%. (Author conclusions modified)

72303

McCain, Joseph D., Joseph P. Gooch, and Wallace B. Smith

RESULTS OF FIELD MEASUREMENTS OF INDUSTRIAL PARTICULATE SOURCES AND ELECTROSTATIC PRECIPITATOR PERFORMANCE. J. Air Pollution Control Assoc., 25(2):117-121, Feb. 1975. 1 ref.

Source size distribution measurements (0.1-5 micron size range) for six classes of industrial particulate sources are presented along with fractional efficiency measurements on five full scale electrostatic precipitators and one pilot scale precipitator. The sources consisted of a coal fired boiler, an open hearth furnace, Kraft recovery boilers, a submerged arc ferro-alloy furnace, a packed-bed sulfur dioxide scrubber, and a spray scrubber following an aluminum reduction furnace. The data obtained indicate a minimum in the collection efficiency versus particle size relationship for the size range between 0.1 and 0.5 micron. Increasing collection efficiencies are obtained for particles larger than a few microns and for particles smaller than 0.1 micron. The latter observation suggests that electrostatic precipitation is a promising means of collecting extremely fine particles. The overall mass efficiencies obtained with the six electrostatic precipitators tested ranged from 96.2-99.8%.

72380

Gooch, John P. and Norman L. Francis

THEORETICALLY BASED MATHEMATICAL MODEL FOR CALCULATION OF ELECTROSTATIC PRECIPITATOR PERFORMANCE. J. Air Pollution Control Assoc., 25(2):108-113, Feb. 1975. 7 refs.

A computerized mathematical model that relates collection efficiency to electrostatic precipitator size and operating parameters is described. Procedures are outlined for calculating particle charging rates, electric field as a function of position in wire-plate geometry, and the theoretical expected collection efficiencies for various particle sizes and precipitator operating conditions. Although calculation of overall collection efficiency of polydisperse particulate material in an electrostatic precipitator from the theoretical relationships results in a consistently higher value than that obtained from performance measurements on full-size units for coal-fired power boilers, corrections applied for estimating the effects of non-uniform gas flow, rapping reentrainment, and gas by-passing the electrified sections reduce the overall values of calculated efficiency to the range of values observed from field measurements. Variation in predicted performance caused by varying the standard deviation of a log normal size distribution with a given mass median diameter is investigated with computer simulation which predicts decreasing performance with increasing values of particle size standard deviation. The decrease results from the influence of the increasing proportions of fine particulate which are present with larger values of standard deviation.

72381

Hall, H. J.

DESIGN AND APPLICATION OF HIGH VOLTAGE POWER SUPPLIES IN ELECTROSTATIC PRECIPITATION. J. Air Pollution Control Assoc., 25(2):132-138, Feb. 1975. 11 refs.

The design and application of high voltage power supplies for electrostatic precipitators is reviewed, with particular emphasis on requirements and methods for achieving the high performance and reliability under various operating conditions and precipitator inputs. Solid-state, automatic voltage and current-limit control with multiple signal feedback loops can provide good regulation and fast response to transient disturbances. Automatic voltage control is typically based on maintaining an optimum average precipitator sparking rate which must be adjustable according to application and dust concentration. Excessive sparking in outlet sections must be avoided so that gains obtained by increasing voltage are not offset by dust losses due to voltage off-time, spark blasting, and reentrainment of dust on the plates. Design and operating requirements of electrostatic precipitators are reviewed in terms of various applications, including high resistivity ash and high temperature and/or high pressure gas treatment. Typical precipitator voltage and current waveforms are illustrated along with a schematic of a modern power supply with automatic voltage and current control.

72380

Coy, David W. and Norman W. Frisch

SPECIFYING PRECIPITATORS FOR HIGH RELIABILITY. J. Air Pollution Control Assoc., 25(2):130-132, Feb. 1975. 8 refs.

The design of electrostatic precipitators of high reliability is discussed. Adequate fuel analysis data are required to design a reliable precipitator system. Average and typical fuel analyses are insufficient for sizing a precipitator to reliably treat a large proportion of the fuel population. The use of a large number (greater than 30) of individual fuel samples, either for individual sizing or for the estimation of a parent population believed representative of the fuel samples, are more reliable approaches. Sufficient redundancy is required to permit sustained operation under conditions of electrical section and other failure. This redundancy is readily defined. Distribution effects, such as those representing gas velocity, gas temperature, even dust concentration, can be significant in reducing the efficiency of a precipitator designed for high efficiency. Methods for adequately compensating for the effects are described.

72413

White, Harry J.

ROLE OF ELECTROSTATIC PRECIPITATORS IN PARTICULATE CONTROL: A RETROSPECTIVE AND PROSPECTIVE VIEW. J. Air Pollution Control Assoc., 25(2):102-107, Feb. 1975. 15 refs.

The growth, applications, technology, problem areas, and future outlook of electrostatic precipitation as the major instrument for the high efficiency control of fine particulate emissions from heavy industry is reviewed. Data are presented for major industrial precipitator installations between 1907 and 1970, the growth in total and fly ash precipitation capacity since 1950, efficiency trends for fly ash, cement kiln, and paper precipitators, annual sales of precipitators in the United States, basic design parameters in practice for fly ash precipitators, and the effect of sodium content on fly ash resistivity. Also included are design factors which should be included in precipitator specification and evaluation and commonly encountered precipitator problems. The ability of electrostatic precipitators to economically remove fine particles in the micron and submicron range and thus meet the newer air pollution control objectives is projected to result in the continued growth of this type of particulate control technology.

73015

A.P.T. Inc., Riverside, Calif.

EPA FINE PARTICLE SCRUBBER SYMPOSIUM (SAN DIEGO, 5/28-30/74). Environmental Protection Agency,

Research Triangle Park, N. C., Control Systems Lab. and A.P.T., Inc., Riverside, Calif., Fine Part. Scrubber Symp., San Diego, Calif., 1974, EPA-650/2-74-112, p. 1-346. 161 refs. (May 28-29) NTIS: PB 238369/AS

Topics dealing with the collection of fine particles (solid or liquid particles smaller than about 3 micron) by any type of wet scrubbing device are presented. Subjects covered include: the public health basis for fine particulate control; engineering design considerations for scrubbers; two-phase jet scrubbers; rotating concentric homogeneous turbulence scrubbers; the effects of water injection arrangement on venturi scrubber performance; transmissometer measurements of mean drop size in full scale venturi scrubbers; the relationship of fine particle collection efficiency to pressure drop, scrubbant and particle properties, and the contact mechanism; flux force/condensation scrubbing; entrainment separators for scrubbers; and future needs for fine particulate control by scrubbing.

75093

Miller, B., G. E. R. Lamb, and P. Costanza

INFLUENCE OF FIBER CHARACTERISTICS ON PARTICULATE FILTRATION (FINAL REPORT). Textile Research Inst., Princeton, N. J., Environmental Protection Agency Contract R-800043, Program Element 1AB012, ROAP 21ADL-033, Rept. EPA-650/2-75-002, 55p., Jan. 1975. 14 refs. NTIS: PB 238907/AS

The influence of five fiber parameters (cross-sectional shape, linear density, surface roughness, crimp, and staple length) on the filtration performance of model nonwoven fabrics was investigated. Nonwoven fabrics made from 32 polyester fiber samples were used to filter fly ash particles from a stream of air. Filter performance was assessed by measuring pressure drop across the filter, collection efficiency, and particle size distribution. The following filtration improvements were statistically observed at 95% confidence: efficiency increased with the use of trilobal (rather than round cross-section) fibers with no detrimental effect on drag; both efficiency and drag were improved by using crimped (rather than uncrimped) fibers; and efficiency was improved by using three (rather than six) denier fibers, though at the cost of greater drag. These efficiency improvements were especially pronounced for fine particles (approximately 2.5 micron). Non-statistically, except for epitropic fibers with very rough carbon-embedded surfaces, rougher fibers appeared more efficient in removing fine particles. The application of direct current voltages to 100% non-conducting polyester filters resulted in considerable efficiency increases. No such effects were observed with polyester filters incorporating 10% epitropic fibers. (Author abstract modified)

75098

Calvert, Seymour, Nikhil C. Jhaveri, and Shuichow Yung

FINE PARTICLE SCRUBBER PERFORMANCE TESTS (FINAL REPORT). A.P.T., Inc., Riverside, Calif., Environmental Protection Agency Contract 68-02-0328, Program Element 1AB012, ROAP 21ADL-037, Rept. EPA-650/2-74-093, 271p., Oct. 1974. 8 refs. NTIS: PB 240325/AS

Various types of stack gas scrubbers were field tested at industrial installations to assess their particle collection performance. The approximate cut diameters (at 50% efficiency) measured were: 1.3 micron for a valve tray type scrubber on a urea prilling tower; 1.2 micron for a vaned centrifugal scrubber on a potassium chloride dryer; 0.4 micron for a mobile bed scrubber on a coal-fired utility boiler; 0.7 micron for a venturi scrubber on a coal-fired utility boiler; 0.8 micron for a wetted fiber scrubber on a sodium chloride dryer; 1.0 micron for an impingement plate scrubber on a sodium chloride dryer; and 0.5 micron for a venturi rod scrubber on a foundry cupola. The test of a hybrid scrubber at a metal melting facility was abandoned due to operating problems. Mathematical models were satisfactory for all of the scrubbers tested except the mobile bed. Data on investment and operating costs and maintenance were generally not available in complete form.

75117

Dennis, Richard and John Wilder

FABRIC FILTER CLEANING STUDIES (FINAL REPORT). GCA Technology Div., Bedford, Mass., Environmental Protection Agency Contract 68-02-0268, Program Element 1AB012, ROAP 21ADJ-049, Rept. EPA-650/2-75-009, GCA-TR-74-6-G, 438p., Jan. 1975. 33 refs. NTIS: PB 240372/AS

Fabric filter cleaning mechanisms were studied in a pilot plant system designed to operate as a single- or multiple-bag unit for the investigation of cleaning by mechanical shaking, pulse jet air, and reverse flow air. Evaluations were performed on four woven bag types (cotton and dacron) and two felt bag types (wool and dacron) using resuspended fly ash and talc dusts. An analysis of cleaning by both mechanical shaking and pulse jet air indicated that the tensile force generated by bag acceleration was the main cause of dust removal; aerodynamic re-entrainment played only a minor role. Residual fabric drag, fabric holding capacity, and dust penetration characteristics were predictable in terms of such cleaning parameters as shaking frequency, amplitude, pulse jet pressure, and rate of pressure rise. Based on an inlet concentration of 3-10 grains/cu ft, effluent concentrations for the mechanically shaken, woven fabrics ranged from 0.000001 to 0.001 grains/cu ft in contrast to 0.001-0.01 grains/cu ft for felted media cleaned by pulse jet air. Effluent concentrations for both systems decreased significantly as the filtration progressed. (Author abstract modified)

75142

Sahagian, J., R. Dennis, and N. Surprenant

PARTICULATE EMISSION CONTROL SYSTEMS FOR OIL-FIRED BOILERS (FINAL REPORT). GCA Corp., Bedford, Mass., Technology Div., Office of Air and Waste Management Contract 68-02-1316, Rept. EPA-450/3-74-063, 81p., Dec. 1974. 34 refs. NTIS: PB 241277/AS

The effectiveness of particulate emission control systems on oil-fired boilers was assessed by reviewing National Emissions Data System files and stack test data from various sampling programs. Emission rates for boilers (100 MW capacity or greater) controlled by electrostatic precipitators average about 3.0 lbs/1000 gal; the effective efficiency for such units is roughly 50% or less for boilers that are well controlled from the combustion standpoint. Inertial collectors of the multicyclone type are generally of little value for controlling oil-fired boiler particulate emissions except for the capture of gross particulates (greater than 10 micron in diameter) in the cold start category. Wet scrubbing systems developed mainly for sulfur oxide removal provide high particulate collection; however, the power requirements to achieve greater than 90% particulate removal and the plume reheating necessary to provide for vapor plume rise and dissipation may exceed those for electrostatic precipitation. Normal variations in fuel oil sulfur and ash content exert no significant effect on particulate emission rates, although the use of fuel additives to regulate ash clogging and cold-end corrosion do produce higher particulate rates. (Author conclusions modified)

73145

Melcher, J. R. and K. S. Sachar

CHARGED DROPLET SCRUBBING OF SUBMICRON PARTICULATE (FINAL REPORT). Massachusetts Inst. of Tech., Cambridge, Mass., Dept. of Electrical Engineering, Environmental Protection Agency Contract 68-02-0250, Program Element 1AB012, ROAP 21ADL-007, Rept. EPA-650/2-74-075, 239p., Aug. 1974. 78 refs. NTIS: PB 241262/AS

Charged droplet scrubbing of submicron particles was theoretically and experimentally investigated for three charging configurations, viz., oppositely charged supermicron drops, uncharged drops, and drops charged with the same polarity as the particles being collected. All three of the configurations showed the same collection characteristics, and in each case charging resulted in dramatically improved collection efficiency as compared to inertial scrubbers. During experiments typical of each configuration, inertial scrubbing by 50 micron water drops of 0.6 micron DOP aerosol particles gave 23% collection efficiency as compared to 65-87% efficiency for self-precipitation of particles with charging (droplets not charged) and 92-95% efficiency for drop and particle charging. Charged drop scrubbing is comparable to wet scrubbing in terms of capital and operating costs and similar to electrostatic precipitation in collection efficiency. (Author abstract modified)

75301

Dismukes, Edward B.

CONDITIONING OF FLY ASH WITH AMMONIA. Environmental Protection Agency, Washington, D. C., Office of Research and Development, Symp. Electrostat. Precipitators Control Fine Part., Research Triangle Park, N. C., 1975, p. 237-257. EPA-650/2-75-016. 11 refs. NTIS: PB 240440/AS

Field tests at Tennessee Valley Authority coal-fired power plants involving the effect of flue gas conditioning with ammonia on the fly ash collection efficiency of electrostatic precipitators are described, with particular emphasis on the mechanisms of collection enhancement. Ammonia conditioning appears to improve the efficiency of fly ash precipitation through two mechanisms. The first consists of a space-charge effect, and the second involves an increase in the cohesiveness of fly ash. The first occurs with fly ash having low to moderately high resistivities, while the second mechanism is observed only with low-resistivity fly ash. Evidence of each mechanism is observed only under circumstances where the properties of the coal and the fly ash as well as the temperature of the flue gas permit significant concentrations of sulfur trioxide (2-11 ppm) to occur in the off gas. The reaction of ammonia with SO3 to produce ammonium sulfate or ammonium bisulfate appears to be a key event in the occurrence of either conditioning process. (Author conclusions modified)

75303

Bakke, Even

WET ELECTROSTATIC PRECIPITATORS FOR CONTROL OF SUBMICRON PARTICLES. Environmental Protection Agency, Washington, D. C., Office of Research and Development, Symp. Electrostat. Precipitators Control Fine Part., Research Triangle Park, N. C., 1975, p. 343-363. EPA-650/2-75-016. 8 refs. NTIS: PB 240440/AS

The operation and applications of continuously sprayed, horizontal flow, parallel plate, solid discharge electrode wet electrostatic precipitators are reviewed, with particular emphasis on collection efficiencies in the submicron range. Optimization of wet precipitator performance requires a uniform velocity profile across the inlet section, which is accomplished by installing U-shaped baffle members in the inlet. After passing through the sections of U-shaped baffles, the dirty gas stream enters the first electrostatic field, and water sprays located above the electrostatic field sections introduce evenly distributed water droplets to the gas stream. The particulates and water droplets pick up charges and migrate to the collecting plates, with the collected water droplets forming a continuous downward-flowing film over the collecting plates to keep them clean. Submicron particulate collection efficiencies of over 98% are reported for applications involving emissions from anode baking furnaces, coke ovens, and prillers.

75801

Cooper, D. W. and D. P. Anderson

DYNACTOR SCRUBBER EVALUATION (FINAL REPORT). GCA Corp., Bedford, Mass., GCA Technology Div., Environmental Protection Agency Contract 68-02-1311, Task 5, Program Element 1AB012, ROAP 21ADL-004, Rept. EPA-650/2-74-083-a, GCA-TR-74-21-G, 116p., June 1975. 14 refs. NTIS: PB 245305/AS

A Dynactor aspirative spray scrubber was tested for power consumption and collection efficiency at three flow rates, two temperatures, two dust loading levels, and with two different dusts. Higher efficiencies were favored by lower flow rate, lower inlet temperature, and higher mass loading. The collection efficiency of the Dynactor was not substantially different from that expected for a well-designed venturi scrubber operating at the same power level and air flow rate. Efficiencies of over 99% were obtained for particles larger than 2.5 micron; for fine particles smaller than 1 micron, the collection efficiency decreased sharply as with other scrubbers of similar power consumption. (Author abstract modified)

75849

Gooch, John P. and Joseph D. McCain

PARTICULATE COLLECTION EFFICIENCY MEASUREMENTS ON A WET ELECTROSTATIC PRECIPITATOR. Kellogg (M. W.) Co., Houston, Tex., Environmental Protection Agency Contract 68-02-1308, Task 21, Program Element 1AB012, ROAP 21ADL-004, Rept. EPA-650/2-75-033, 4p., March 1975. 6 refs. NTIS: PB 244173/AS

Fractional and overall particulate collection efficiency measurements were made on a plate type wet electrostatic precipitator collecting fume from an aluminum pot line. Overall collection efficiency determinations, based on a mass train with an instack filter, ranged from 93.0 to 99.0%. The mass filter obtained much higher total outlet mass loadings than did the Andersen impactors, presumably because of large entrained liquid droplets which were captured by the mass traverse, but not by the single point impactor measurements. The average minimum collection efficiency in the size range 0.3 to 1.0 micron diameter, based on the Andersen data, was 98.5%. Comparisons between collection efficiencies measured with Andersen impactors and predicted with a mathematical model of an electrostatic precipitator indicated fair agreement in the size range from 0.2 to about 1.3 micron. The relationship of collection efficiency to particle size departed drastically from the expected pattern, for larger particles, possibly because of liquid carryover from the electrode irrigation system. (Author abstract)

77063

Epstein, Michael

EPA ALKALI SCRUBBING TEST FACILITY: SUMMARY OF TESTING THROUGH OCTOBER 1974. Bechtel Corp., San Francisco, Calif., Environmental Protection Agency Contract 68-02-0617, Program Element 1AB013, Rept. EPA-650/2-75-047, 486p., June 1975. 19 refs. NTIS: PB 244901/AS

Test results from March 1972 to October 1974 from a lime/limestone scrubbing test facility for removing sulfur dioxide and particulates from flue gases are described. The facility consists of three parallel scrubbers: a venturi spray tower, a Turbulent Contact Absorber (TCA), and a marble bed absorber, each able to treat a 10 MW equivalent of flue gas from a coal fired boiler. Limestone factorial tests were conducted on all three scrubbers to determine the effects of the independent variables on SO2 and particulate removal. Limestone reliability verification tests were conducted on all three scrubbers to define regions for scale free operation. Lime and limestone reliability tests were conducted on the venturi spray tower and TCA systems to demonstrate long term reliability, primarily of the mist elimination systems. Mathematical models have been developed for predicting system performance. Test results show that scrubber internals can be kept relatively free of scale if the sulfate saturation of the scrubber liquor is kept below about 135%. The TCA mist elimination system has remained essentially clean over a 1000 hr period at a superficial gas velocity of 8.6 ft/sec. The spray tower has a chevron mist eliminator with provision for underside and topside wash. Neither intermittent nor continuous bottomside wash prevented solids buildup at 6.7 ft/sec superficial velocity and 8% slurry solids concentration. A recent test has shown that a combination of intermittent topside and bottomside wash can keep the mist eliminator free of solids at the above conditions. (Author abstract modified)

77208

Stukel, J. J. and H. G. Rigo

ENERGY EFFICIENCIES OF AIR POLLUTION CONTROL DEVICES. Atmos. Environ., 9(5):539-545, May 1975. 11 refs.

A thermodynamic analysis of the minimum energy requirements of various control devices used for removing gaseous and particulate pollutants from gas streams at various levels of collection efficiency is presented. Equations for calculating the energy efficiency (effectiveness) of various control devices are given as a function of both system energy losses and operating and maintenance costs. A plot of the energy efficiency associated with a single cyclone, an electrostatic precipitator, a fabric filter, and a venturi scrubber obtained by relating the actual energy required and the theoretical energy calculated for each device reveals extremely low energy efficiencies associated with all of the devices. The most efficient device, the electrostatic precipitator, possesses an efficiency of 0.1%, while the venturi scrubber which is the most energy intensive abatement device of the four possesses an efficiency of 0.008%. The effectiveness of both in terms of power consumption and cost is tabulated for sulfur dioxide control devices utilizing throw-away and regenerative scrubbing processes and dry processes of the catalytic oxidation and copper adsorption type.

77270

Selle, Stanley J., Lindsay L. Hess, and Everett A. Sondreal

WESTERN FLY ASH COMPOSITION AS AN INDICATOR OF RESISTIVITY AND PILOT ESP REMOVAL EFFICIENCY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1975. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-02.5.)

Pilot-scale electrostatic precipitator performance tests were run on a high and low resistivity western fly ash and mixtures thereof. The fly ashes were collected from full-scale electrostatic precipitator hoppers and reentrained in a flue gas of constant analysis ahead of a 130 standard cu ft/min pilot precipitator. Fly ash composition and measured resistivity were good indicators of precipitator performance. Reentrained high-sodium fly ash acted as an electrostatic precipitator conditioning agent for high resistivity fly ash. The addition of only 0.75% of the high sodium fly ash increased the effective migration velocity from 0.3 to 0.8 ft/sec at 300 F. Similar results were obtained at 475 F. Computer regression analysis correlating laboratory fly ash resistivity with chemical analysis substantiated the inverse relationship between resistivity and sodium oxide content of the fly ash. (Author abstract modified)

77280

Stone, Richard C., Roger C. Trueblood, and David O. Young

A PILOT PLANT APPROACH TO SPECIFYING ELECTROSTATIC PRECIPITATORS ON LOW SULFUR WESTERN COAL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1975. (Presented at the Air Pollution Control Association Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-02.6.)

Results from over 100 pilot plant tests to determine specifications for electrostatic precipitators serving thermal power plants burning low-sulfur western coal are presented. Tests with a three-stage electrostatic precipitator over a temperature range of 250-800 F indicate that fly ash exhibits a moderately high resistivity at conventional temperatures (300 F); it can, however, be collected in a reasonably sized low-temperature precipitator. Outlet grain loading varies inversely with the specific collecting area, being lower for higher collecting areas. (Author abstract modified)

77290

Robinson, John W.

WET SCRUBBER APPLICATION TO HOGGED FUEL BOILERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1975. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.3.)

The use of wet scrubbers for controlling particulate emissions from two tangentially fired gas boilers burning hogged wood or southern pine bark fuel is described. The installation consists of two scrubbers mounted in parallel on each of two stacks. The scrubbers utilize centrifugal force by sharply changing the direction of gas flow to impinge dirty gas on the water surface to capture particulate matter. The total cost of the scrubber installation is $240,000. The measured particulate emission rate for each stack is 7.4 lb/hr, and, based on an average inlet dust loading of 330 lb/hr, the overall efficiency is estimated to be 97%.

77300

Walton, John W., Ernest C. [illegible], and Boyd R. McInnis

AIR POLLUTION IN THE WOODWORKING INDUSTRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 12p., 1975. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-16.1.)

High volume stack samplers were used to make field evaluations of particulate emissions from cyclones serving wood-fired boilers used in woodworking operations. Most woodworking cyclones were found to be below 20% equivalent opacity. Cyclones having higher visible emission levels generally contained sanding dust. A grain loading standard based on the high volume sampler method appeared to be the best method for regulating the woodworking industry because of the numerous problems associated with accurately establishing process weight inputs.

77675

Noll, Kenneth E. and Wayne T. Davis

THE GENERATION AND EVALUATION OF FABRIC FILTER PERFORMANCE CURVES FROM PILOT PLANT DATA. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 39p., 1975, 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-07.6.)

The basic relationship between pressure drop variations with time and various dust/fabric combinations was determined in a systematic study on two test facilities. Performance curves show that the pressure drop during the early stages of the filter cycle depends on both the fabric structure and the dust characteristics. The residual pressure drop of conditioned fabrics is also a function of the fabric and dust. A performance curve which shows a large rate of increase in pressure drop during the initial cake formation on a clean fabric has the potential for a high residual pressure drop for the conditioned fabric. After a homogeneous cake has formed on a filter, further increase in pressure drop is a function of the dust characteristics only, as would be predicted by application of Darcy's law. This applied to both a clean and conditioned fabric. The collection efficiency for fabrics appears to be related to pressure drop, with higher efficiencies associated with fabrics demonstrating lower pressure drops. The thicker all-spun and felted fabrics have performance curves with lower pressure drops and significantly higher removal efficiencies than the filament or combination fabrics. (Author abstract modified)

77677

Iinoya, Koichi, Kazutaka Makino, and Noriaki Izumi

OPTIMAL DESIGN OF A FABRIC FILTER SYSTEM. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 19p., 1975, 1 ref. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-07.3.)

A process for the determination of the optimal design of a fabric filter system was developed by formulating an economic evaluation function based on the cleaning cycle for both timer and pressure switch type filter systems. The annual cost is formulated in terms of the fixed and operating costs of a fan, the fixed cost of a filter and the fabric replacement cost. Assuming that the fabric life is constant or is equal to the allowable repetitions of cleaning cycles, the economically optimal operating conditions, such as the maximum pressure loss, average filtering velocity, number of compartments, and cleaning period are calculated to minimize the annual cost of a newly designed unit. The optimal number of compartments depends on the inlet dust concentration. For a system in which the fabric life is limited by the repetitions of the cleaning cycles, the optimal operating conditions depend on the dust concentration and the number of compartments. For a pulse cleaning type filter system with constant fabric life, the concentration may not affect the optimal conditions. (Author abstract modified)

77678

Spitz, Albert W.

CONTROL OF EMISSIONS FROM SECONDARY METALS RECOVERY AND ASPHALT PAVING PLANTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 11p., 1975. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-30.7.)

Typical emission control systems, installed within the last 5 yr for brass, bronze, and aluminum ingot makers, secondary copper, lead, and zinc smelters, and asphalt paving plants are reviewed. For a Cu based ingot maker, a water spray and dilution air cooling system is used with a baghouse. Fumes from a Zn alloy recovery furnace are controlled with a baghouse with a calcium carbonate precoat. The pollution potential of Al scrap processing is described along with several solutions. The use of precoated houses in the secondary Al industry is increasing. Pilot scale filter installations are recommended. Asphalt paving plant pollution control systems are under revision with pulse jet baghouses replacing wet scrubbers.

77680

Fraser, Malcolm D.

A PREDICTIVE PERFORMANCE MODEL FOR FABRIC FILTER SYSTEMS. II. MULTICOMPARTMENT SYSTEMS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 11p., 1975, 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-07.7.)

A predictive performance model for a multicompartment fabric filter system was developed based on the fundamental principles involved in fabric filtration. The equilibrium pressure-drop cycle which results from switching compartments off and on-line is calculated in an exact manner from the basic equations by an iterative algorithm. Comparison of predictions from this model with real performance data indicates that this model shows promise for predicting the collection efficiency of multicompartment fabric filter systems and for simulating their behavior under changed inlet or operating conditions. (Author conclusions modified)

77681

Zahedi, K. and J. R. Melcher

ELECTROFLUIDIZED BEDS IN THE FILTRATION OF SUBMICRON PARTICULATE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1975, 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-07.8.)

The use of an electrofluidized bed (EFB) consisting of fluidized particles with an imposed electric field in either the flow direction (co-flow) or perpendicular to the flow direction (cross-flow) as a high performance particulate control device is discussed. By dint of the electric field, the bed particles (whether conducting or insulating) obtain positive and negative charges on their respective ends. Experiments are described for the co-flow configuration used to collect 0.7 micron DOP particles. A slug-flow model is developed showing the way in which efficiency depends on unfluidized bed height, bed-particle size, particulate mobility, gas flow-rate and applied electric field intensity. This model is successfully correlated with tests in which flow rate, bed particle size, and unfluidized bed height are varied. Efficiencies better than 99% can be achieved in collecting 0.7 micron DOP with a gas residence time less than 50 msec and a pressure drop of about 6 cm of water. (Author abstract modified)

77930

Stephens, H. Thomas, J. Martin Hughes, Bruce W. Owen, and William O. Warwick

EMISSIONS CONTROL AND AMBIENT AIR QUALITY AT A SECONDARY STEEL PRODUCTION FACILITY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-15.5.)

A case study of dust and fume emission control measures and their impact on ambient air quality in the surrounding area is presented for a secondary steel production facility using electric arc furnaces. Emission control measures include a mechanical cyclone and a number of baghouses with side draft hood evacuation. Measurement of the ambient air quality near the plant with high-volume samplers indicate that the impact of the facility on the surrounding community is minimal, with mean particulate concentrations near the plant differing little from those recorded in a nearby residential area. Visible emissions, however, are still a source of complaint from local officials. The most difficult problem is emission control during charging; the predominant furnace in use is a top-charged type which releases fume emissions when the roof is off during charging.

78050

Fauro, F., R. B. Jacko, and R. Squires

THE COLLECTION EFFICIENCY OF AN ELECTROSTATIC PRECIPITATOR FOR TRACE METALS FROM AN OPEN HEARTH FURNACE. National Science Foundation, Washington, D. C., Research Applied to National Needs, Trace Contam. Conf. Proc., 2nd Annu., Pacific Grove, Calif., 1974, p. 64-68. 3 refs. (Aug. 29-31.) NTIS: LBL-3217

Emission tests both upstream and downstream of an electrostatic precipitator controlling a battery of seven open hearth furnaces revealed an average particulate collection efficiency of 97.7%. An apparent minimum collection efficiency at the 4 micron particle size level appeared to be due to the transformation of particle sizes within the precipitator. Agglomeration of 1-micron particles to an effect 4-micron size appeared to be the primary reason for the pseudo efficiency decrement at 4 micron. Average particulate concentrations upstream and downstream of the precipitator were 0.149 and 0.008 grains/standard cu ft, respectively. Total particulate mass emission rates varied from 35-64 lb/hr and resulted in a calculated emission factor of 0.10-0.66 lb particulates/ton of steel produced. The mass median diameter of the particles entering the precipitator was 1.58 micron and that of the particles leaving the precipitator was 1.0 micron. (Author abstract modified)

79178

Wright, R. J.

SELECTION AND APPLICATION OF PARTICULATE CONTROL DEVICES IN THE STEEL INDUSTRY. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1975 (?), Chapt. 9, p. 153-160.

Various points of particulate emissions and possible methods for control in the steel industry are discussed. Dust is produced when raw materials are transferred from the rail car to the hopper, from the stock house to the weigh car, and from the weigh car to the skip car. Fabric filters are used for all three transfers. No simple approach has been found for control of particulates from coke ovens. Scrubbers are often used. Emissions from the blast furnace are principally from the slagging and cast house, which use scrubbers, fabric filters, and, occasionally, precipitators. Generally, the open hearth is controlled either by an electrostatic precipitator, a scrubber, or a glass fabric baghouse. The BOF-LD is controlled by either electrostatic precipitators or high energy scrubbers. Tapping directly from the arc furnace or other refined steel processes to a continuous casting machine presents some transfer problems requiring small amounts of fabric, usually glass cloth for filter dust control. Because of the abrasive nature of mill scale, an ample hopper is employed as a primary collector and, depending on the amount of dust involved, a mechanical collector is used as a precleaner and primary collector ahead of fabric or wet scrubbers. Both grinding and polishing are usually shielded in a liquid coolant, eliminating the need for collection equipment. High efficiency, continuously cleaned, impingement air filters are used for the motor control center and personnel control rooms and cubicles. When heavier ambient air dustloads are experienced the supplemented media precoated fabric filter can be installed.

79179

Henderson, J. S. and J. E. Roberson

THE PULP AND PAPER INDUSTRY PRECIPITATOR SURVEY. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1975 (?), Chapt. 10, p. 161-172. 3 refs.

A precipitator survey was conducted, covering collector units placed in operation since January 1, 1966, and with a collection efficiency of at least 98.0%. The survey questioned design data, collector construction, collector performance, and operating experience. Maintenance costs, problem areas, and stack test results were included. Responses covered 38 wet bottom precipitator units applied to conventional recovery boilers and four dry bottom precipitators as applied to noncontact recovery boilers. The performance aspects of precipitators are discussed. Inlet particulate loadings consist of a range of values. Approximately 70% of the precipitator tests were at less than guaranteed efficiency. A 99.0% guaranteed efficiency resulted in a long term operating efficiency of 98.4%. Only half of the respondents kept specific maintenance cost records on their precipitators, while 75% of the respondents have performed both guaranteed tests and routine operating tests of their precipitators. The results for the dry bottom precipitators parallel those of the wet bottom precipitators, except for downtime and maintenance costs. Downtime attributed to dry bottom averaged 200 hr versus 30 hr per yr for wet bottom units. Corresponding maintenance costs were higher for dry bottom units. (Author abstract modified)

79180

Clark, David

CONTROL OF EMISSIONS IN THE CEMENT MANUFACTURING INDUSTRY. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1975 (?), Chapt. 11, p. 173-178.

Emission control in Portland cement manufacturing is discussed as it relates to attainment of ambient air and point source mass emission standards. The processes for reducing particulate emissions from the procurement of raw materials are described. The feeders used for mixing raw materials are generally controlled sufficiently using shrouds and conveyor shields. A wet scrubber is the most commonly used dust control equipment in the wet process raw grinding operation and may also be used to control emissions from the mixing stage. The raw grinding stage has an exceptionally high mass emission potential in the dry process. Continuous temperature control is necessary to avoid blinding the fabric filters used to control emissions while drying the raw materials. The exhaust gases from the burning phase and the quick cooling operation following it are the most difficult conditions in the control of emissions from the entire process. The control methods used include electrostatic precipitators and fabric filters. Fabric filters are the mainstay of emission control from finish grinding. The fabric filter is also the most used collection device in cement storage and distribution. Although large quantities of fine material are transferred through this step, proper application of transfer points shrouds and conveyor covers, the use of high level silo alarms to avoid silo overfill and adequately sized fabric filters, minimize the emission of cement dust.

79186

Bradstreet, Jeffrey W. and Robert J. Fortman

STATUS OF CONTROL TECHNIQUES FOR ACHIEVING COMPLIANCE WITH AIR POLLUTION REGULATIONS BY THE ELECTRIC UTILITY INDUSTRY. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1974 (?), Chapt. 18, p. 365-385. 22 refs.

The ability of electric utilities to select control equipment that will afford compliance with the Federal air pollution regulations is quite limited. It is possible to control particulates to the extent required with the possible exception of low sulfur fuel used to limit sulfur oxide emissions. Flue gas desulfurization processes have not developed sufficiently to provide reliable removals consistent with the operation of the boiler. Nitrogen oxide control has only advanced to combustion modification techniques for gas fired units, and possibly oil fired units. Control of nitrogen oxide emissions from coal fired units is an undeveloped art. Compliance with the nitrogen oxide emissions is, therefore, impossible for coal fired plants. (Author abstract modified)

81387

Grzywinski, Richard J.

UPDATING INCINERATORS FOR AIR POLLUTION ABATEMENT. Public Works, 105(12):48-50, Dec. 12, 1974.

The installation of a particulate control system on a continuous type municipal incinerator with an actual daily capacity of 750 tons/day is described. The heart of the control system is an electrostatic precipitator. Gas entering the precipitator is controlled to a temperature of 550 F by a bank of 30 air-atomized water spray nozzles with control valves which respond to the precipitator inlet temperature. Sufficient retention time for the spray water droplets to evaporate before entering the precipitator is provided by two in-line steel towers. Although the performance of the precipitator is not yet verified, visual results are encouraging. The total project cost for particulate control system is $1,319,000.

82702

Hughes, J. Martin, N. Thomas Stephens, and R. Anthony Glenn

ELECTROSTATIC PRECIPITATION ASSESSMENT FOR LIGHTWEIGHT AGGREGATE PRODUCTION. Preprint, 12p., 1975. 10 refs.

Stack sampling and laboratory tests were conducted to determine optimum operating parameters for the proposed installation of an electrostatic precipitator at a lightweight aggregate production plant. Operating conditions were characterized for a natural gas aggregate kiln producing at a rate of 40 tons/hr. Gas emission temperatures in the neighborhood of 700 F and moisture levels in the 20% range were found satisfactory for the desired particulate collection efficiency of 98.0%.

82704

Hobson, M. J.

REVIEW OF BAGHOUSE SYSTEMS FOR BOILER PLANTS. J. Air Pollution Control Assoc., 26(1):28-32, Jan. 1976.

Data on the operation of baghouse systems used for the control of particulates from fossil fuel boilers were obtained from 10 commercial installations. The installations consisted of power utility plants and industrial boiler plants. Gas flows treated ranged from 27,000 to 820,000 cu ft/min. Although operating and performance data were limited, a strong relationship appeared to exist between air to cloth ratio and bag life. Collection efficiencies were generally high.

82705

First, Melvin W. and William C. Hinds

HIGH VELOCITY FILTRATION OF SUBMICRON AEROSOLS. J. Air Pollution Control Assoc., 26(2):119-123, Feb. 1976. 10 refs.

The filtration efficiency of a fiberglass mat filter medium was investigated using a dioctylphthalate aerosol having a count median diameter of 0.8 micron and uniform polystyrene latex spheres of 0.36-1.1 micron diameter over a face velocity range of 500-5000 ft/min. Penetration curves for the liquid DOP aerosol and the solid spheres showed reasonable agreement up to a face velocity of 1000 ft/min. At higher velocities, however, the polystyrene latex sphere penetration increased, whereas the DOP penetration showed a continuing decrease. This suggests that some fraction of the solid particles can either bounce back into the air stream after contacting a fiber or be trapped and later reentrained in the air stream, whereas liquid particles adhere on contact with a filter fiber.

82706

Burchard, John K.

SIGNIFICANCE OF PARTICULATE EMISSIONS. J. Air Pollution Control Assoc., 26(2):99-100, Feb. 1976. 3 refs.

Fine particulate emissions (liquid and solid particles less than 3 micron in diameter) are discussed in terms of their effects on human health and methods for their control. Fine particulates exert their principal effect on health through inhalation and direct attack on the respiratory system which may be manifested by short term irritant effects or longer term damage in the form of emphysema, bronchitis, and pneumoconiosis. High efficiency electrostatic precipitators are capable of removing particles with diameters down to 0.1 micron with an efficiency as high as 98%. However, the range of applicability of conventional precipitators is limited to a fairly narrow range of particle resistivity. Hot-side precipitators appear to offer greater promise for the control of fine particulates.

84729

Drehmel, Dennis C.

PRIMARY FINE PARTICLE CONTROL TECHNOLOGY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1976. 13 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-50.5.)

Recent Environmental Protection Agency-sponsored development of particulate control for stationary sources stresses fine particulates and has been directed toward characterization and improvement of conventional equipment and assessment of the collectability of dusts. Studies of electrostatic precipitators showed that collection efficiency does not decrease rapidly as a function of decreasing particle size. Assessment of scrubbers of various kinds (sieve tray, vaned centrifugal, mobile bed, venturi, wetted fiber, impingement plate, and venturi rod) revealed that collection efficiency for all varieties was initially high and decreased rapidly with decreasing particle size. Fabric filters proved to be highly efficient fine particle collectors. Several novel devices, many of which were scrubbers using water, were also tested. Projects have been initiated to study new concepts in particulate control: charged droplet scrubbers; electric curtains; electrostatic filter beds; foam scrubbing; cleanable double media cartridge filtration; electrostatic effects in fabric filtration; high gradient magnetic separation; and ceramic membrane filtration.

84731

Weinstein, Norman J. and Richard F. Toro

PARTICULATE EMISSION CONTROL FOR THERMAL PROCESSING OF MUNICIPAL SOLID WASTE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1976. 36 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-37.5.)

Electrostatic precipitators, scrubbers, and fabric filters used to control particulate emissions from incinerators are discussed. Design parameters, operating efficiency, and costs are described. The attainment of legal emission standards is stressed.

84741

Padgett, Joseph and J. D. Bachmann

REGULATORY AND TECHNICAL CONTROL STRATEGIES FOR FINE PARTICLES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1976. 31 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-38.7.)

The implications of available information for fine (less than 3 micron) particulate control strategies is discussed. Available information on health effects does not permit the establishment of adequate dose/response functions for fine particles. But preliminary research indicates that some adverse effects may be associated with certain fine particulate classes even when current total suspended particulate (TSP) standards are met. Three approaches to control are discussed: control of emissions of gaseous precursors, which account for the major portion of fine particulate mass; control of the mechanisms which promote the transformation of gases to particles; and control of direct emissions of fine particles. A general fine particulate standard would not necessarily ensure against effects from specific chemical compounds and would not obviate the need for separate regulatory programs for such toxic particulates as lead and other trace elements, acid aerosols such as sulfates and nitrates, and carcinogens such as certain polycyclic organics. Recent evidence suggests an approach which places greater emphasis on the control of selected categories, fine particulate matter, especially sulfates and nitrates, which continued reliance on the current TSP standard for overall control.

84743

Robison, Ernest B.

APPLICATION OF DUST COLLECTORS TO RESIDUAL OIL FIRED BOILERS IN MARYLAND. State of Maryland Department of Health and Mental Hygiene, Baltimore, Md., Environmental Health Administration, Rept. BAQC-TM 74-18, 18p., Dec. 1974. 8 refs.

The experience of the Maryland State Bureau of Air Quality Control in the development, adoption, and implementation of regulations to control particulate emissions by requiring dust collectors on residual oil-fired boilers is discussed. The regulations specified maximum allowable particulate emissions varying from 0.03 gr/SCFD to 0.02 gr/SCFD at 50% excess air for very large existing units. The limit for new large users was set at 0.01 gr/SCFD. The regulations also specified the performance efficiency of the dust collector: between 50 and 80% based on an inlet grain loading of 0.060-0.067 gr/SCFD. At the time of the regulations (Dec. 1970), the suspended particulate in the Baltimore area was about 160 microgram/cu m, well above the Environmental Protection Agency standard of 75 microgram/cu m. In 1974, although the Federal primary standard has not yet been met, there has been a substantial reduction. Extensive studies and surveys have shown that when emission is substantial, the axial flow and multicyclone collectors can remove most of the ash from steady-state operation and virtually all of it during soot blowing. Burner and collector maintenance are essential. Dust collectors in rotary cup burners tend to collect more dust. Exceptions are noted: these burners tend to operate with too much excess air and to be sensitive to fuel viscosity.

84744

Reynolds, Joseph P., Antony Mercando, and Louis Theodore

THE EFFECT OF VOLTAGE ON TWO-STAGE ELECTROSTATIC PRECIPITATOR COLLECTION EFFICIENCY; COMPARISON BETWEEN MODEL AND EXPERIMENT. Preprint, Manhattan College, N. Y., 13p., 1976. 9 refs.

The Theodore model used in the design of electrostatic precipitators is discussed. Experimental collection efficiencies for a small 2-stage commercial electrostatic precipitator operating under a variety of ionizer and collector voltages are presented, and these are compared with efficiencies predicted by the Theodore model. The Theodore model, like the original Deutsch-Anderson model, is based on physical principles, but the underlying assumptions differ from those of the Deutsch-Anderson equation, and the results correlate better with field test data. A fair agreement was found between calculated and experimental values, but the correlation would have been better had accurate equations to describe the electrical fields been available. The Theodore model may be better suited to the needs of the electrostatic precipitator industry than the current empirical methods, because the empirical methods require that the values of the effective drift velocity be known beforehand.

84751

Hersh, Stuart, John P. Hurley, and Robert C. Carr

THE EFFECTS OF SMOKE SUPPRESSANT ADDITIVES ON THE PARTICULATE EMISSIONS FROM A UTILITY GAS TURBINE. Air Pollution Control Assoc., Pittsburgh, Pa., 19p., 1976. 14 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-8.1.)

The effects of additive use on the particulate matter emissions (mass, size, and composition) for base load turbine operation were studied. Tests were made on a utility gas turbine representative of current combustor operation which required the use of a fuel additive for control of visible smoke. An attempt was made to totally characterize the effect of additive use on the solid and gaseous emissions from the turbine. Selected concentrations of 3 different smoke suppressant additives representing the most widely used additive types were studied. Representative exhaust samples were extracted from the gas turbine stack and analyzed for total particulate mass loading and composition, particle size distribution, size and chemical state of the emissions derived from the additive base element, polycyclic organic matter, and gaseous emissions including nitrogen dioxide, nitric oxide, carbon monoxide, oxygen, unburned hydrocarbons, sulfur dioxide, and sulfur trioxide. Tests were conducted at both industrial base load (nominally 20 MW) and an intermediate load of 11 MW. The results indicate that the chief effect of the additives is to reduce the mass loading of carbon in the effluent gas. The additive base element appeared in the exhaust as relatively large particles (about 1 micron diameter). The relative quantities of manganese (2+)/Mn(3+) in the exhaust were 70/30% and 90/10% for manganese-barium and manganese additives, respectively. For an iron-based additive, 15% of the iron appeared as Fe(2+) with the remaining 85% being Fe(3+). The data lend support to the contention that the decreased opacity observed with the use of fuel additives results from a decrease in the total carbonaceous emissions.

84757

Turner, J. H.

RESEARCH AND DEVELOPMENT OF DUST COLLECTORS IN THE U. S. WITH EMPHASIS ON FABRIC FILTRATION. Preprint, Industrial Environmental Research Laboratory, Research Triangle Park, N. C., 8p., 1976. 44 refs.

Research and development of dust collectors is discussed, with emphasis on fabric filtration and some discussion of scrubbers, electrostatic precipitators, and novel devices. Measurement methods pertaining to field and laboratory particle size and concentration measurements are briefly described. Research includes work on cleaning the filter systems, the effect of filter drape on collection efficiency, and the development of fabrics capable of withstanding high temperatures. High velocity filtration, mathematical filtration models, and dual purpose filters used for sorption of gas as well as collection of particulates are discussed.

84775

Leith, David and Melvin W. First

FILTER CAKE REDEPOSITION IN A PULSE-JET FABRIC FILTER. Preprint, The Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1976. 9 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-31.4.)

To the extent that a filter cake of collected dust redeposits rather than falls to the hopper, pulse-jet filter cleaning is ineffective. Dust tracer techniques were used to identify the extent to which redeposition occurs. Dust redeposition upon the pulsed bag itself was found to increase markedly with increasing velocity, although migration and redeposition on bags adjacent to the pulsed bag decreased. Darcy's law was found to predict accurately the relationship between pressure drop and velocity only when the increased dust deposit thickness due to redeposition was considered. For high velocity pulse-jet filters to operate at their lowest possible pressure drop, filter cake redeposition must be minimized. (Author abstract)

C. MEASUREMENT METHODS

18971

Boubel, Richard W.

A HIGH VOLUME STACK SAMPLER. Preprint, Air Pollution Control Assoc., Pacific Northwest International Section, 10p., 1970. 7 refs. (Presented at the Air Pollution Control Association, Pacific Northwest International Section, Annual Meeting, Spokane, Wash., Nov. 16-18, 1970, Paper 70-AP-5.)

The design and operation of a high volume stack sampler with application to hog fuel fired boilers, bark fired incinerators, wigwam burners, asphalt plants, and seed cleaning cyclones are reviewed. Probe construction and calibration, operating procedure, and field evaluation results are examined. The sampler is rapid, reliable, relatively simple, and inexpensive. (Author abstract modified)

10707

Hwang, Jae Y., Paul A. Ullucci, and Charles J. Mokeler

TRACE ANALYSIS OF ATMOSPHERIC POLLUTANTS BY SOLVENT EXTRACTION - FLAMELESS ATOMIC ABSORPTION SPECTROMETRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1971. 6 refs. (Presented at the Air Pollution Control Association Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971.)

Trace elements of silver, cadmium, zinc, and lead in atmospheric particulate samples were determined by solvent extraction flameless atomic absorption techniques. Air particulate samples were collected on organic membranes by a low volume air sampler. The membranes with the samples were pretreated with acetone before acid extraction. Sample solutions, thus prepared, were further extracted into organic solvents. The final organometallic complexes in organic solvents were then dried, pyrolyzed, and atomized in an enclosed chamber under an inert gas atmosphere for atomic absorption measurements. To improve the accuracy of the analysis, a thorough investigation into the chemical interferences was made and the interferences were compared between the present and conventional atomic absorption techniques. This technique is simple and runs with good sensitivity and precision. It is ideal for the trace analysis of atmospheric particulate samples for a short-term variation study. (Author abstract modified)

11612

Ettinger, Harry J. and George W. Royer

PARTICLE SIZE, VISIBILITY AND MASS CONCENTRATION IN A NON-URBAN ENVIRONMENT. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 27p., 1971. 22 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-81.)

An air sampling program was carried out in a non-urban, low pollution area to relate: total particulate mass concentration measured with a high-volume sampler, particulate mass distribution measured with aerodynamic size selective samplers, and visual range as defined by the integrating nephelometer. For low suspended particulate mass concentrations, the following relationship was defined between visual range (L sub v) and mass concentration (M, micrograms/cu m): L sub v equal to 900/M miles. Particle size analysis obtained with the Andersen impactor and Cascade Centripeter show varying mass median size, but generally follow similar size distributions. Comparison of the three suspended particulate samplers shows that those samplers measuring size characteristics, indicate mass concentrations approximately 30% lower than total suspended particulates defined by high volume samplers. (Author abstract modified)

12257

Warner, P. O., L. Saad, and J. O. Jackson

IDENTIFICATION AND QUANTITATIVE ANALYSIS OF PARTICULATE AIR CONTAMINANTS BY X-RAY DIFFRACTION SPECTROMETRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1971. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971.)

Because of the synergistic effects which occur from the mixing of gases and particulates in ambient air, it is important that the determination of air pollutants be conducted on the sample in its native state without imposing any further chemical recombination during the analysis. X-ray diffraction spectrometry allows such a non-destructive method of analysis. It is suited for the identification of proprietary, but crystalline, mineral particulates, such as cement powder, slag dust, sinter emissions, and graphite coke. Powdered glass is used as a solid diluent. The most significant application of this method is the rapid quantitative determination of coke particulate in the presence of coal, where these materials are stored under conditions which may lead to their commingling. This method allows the rapid, relatively interference-free determination of materials, such as industrial binders, molding sands, mill scale, and carbonaceous particulates which possess some degree of crystallinity. The method was extended to the study of such gases as sulfur dioxide, which may be selectively fixed to an active surface. Data have also been gathered to show the effects of various gas-solid interfacial reactions on the diffraction patterns of particulates.

12411

Dorsey, J. A. and J. O. Burckle

PARTICULATE EMISSIONS AND PROCESS MONITORS. Chem. Eng. Progr., 67(8):92-96, Aug. 1971. 10 refs.

Increasing efforts to define the extent of air pollution and develop control technology for particulate emissions has shown the many disadvantages of applying manual methods to routine measurement on a major scale. The most significant of these are the high cost of performing a series of tests, and the inability of the techniques to provide a continuous record of instantaneous emission rates. The accuracy of a particulate mass monitor is ultimately a function of the representativeness of the sample, and the degree to which the sensor responds to true mass. The most significant factors influencing both areas are the properties of the particulate matter or, more precisely, the net effect of the properties of many minute, discrete particles. These include particle size, shape, density, color, resistivity, and composition. In addition to the physical and chemical properties of the particles, the effects of gross flow of particulate in the source must be carefully considered. Sampling techniques and sensing principles are discussed. For in situ measurements, the absorption of visible light, gamma rays, and acoustical energy have been investigated.

33502

Olin, John G., Gilmore J. Sem, and Richard P. Trautner

AIR QUALITY MONITORING OF PARTICLE MASS CONCENTRATION WITH A PIEZOELECTRIC PARTICLE MICROBALANCE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 11p., 1971. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-1.)

The particle mass monitor is specifically designed for continuous air quality monitoring and effectively replaces the filter-weighing procedure with an automatic instrument. The sensor consists of an oscillating quartz crystal. An electrostatic precipitator deposits the particles with nearly 100% collection efficiency onto the surface of the vibrating crystal. Trace amounts of a gas are emitted by a constant-temperature permeation tube into the inlet aerosol stream to make the particles firmly adhere to the crystal surface. The background error caused by this trace gas is negligible. The resonance frequency of the crystal decreases linearly with the mass of the particulate deposition and is monitored and recorded with a digital counter and printer. The time rate-of-change of frequency is proportional to particle mass concentration. Simultaneous measurements show good comparison of the particle mass monitor with the parallel membrane filter, good reproducibility, an upper particle size limit as high as 20 micron for the aerosol tested, and a time response of 30 sec or less. Measurements with a high-volume sampler were approximately a factor of two higher than those obtained with the parallel filter and particle mass monitor, probably because the high-volume sampler collected a significant number of very large particles in the 50 to 300 micron range. (Author abstract modified)

33566

Shannon, Larry J., A. Eugene Vandegrift, and Paul G. Gorman

ASSESSMENT OF SMALL-PARTICLE EMISSIONS (LESS THAN 2 MICRON). Preprint, California Air Resources Board, Sacramento and California State Dept. of Public Health, 11p., 1971. 14 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 12th, Los Angeles, Calif., April 6-8, 1971.)

Standard sampling and particle sizing methods applied to the fine particle regime are evaluated for information on (1) total mass and fine particle emissions and (2) particle size and fractional efficiency. The method and results of calculations of fine particle emissions from major industrial sources are given. Cascade impactors, thermal precipitators, micro-particle classifiers, Coulter counters, differential sedimentation devices, and microscopic techniques are discussed.

41984

Wilson, Kent D. and Dennis A. Falgout

A NEW APPROACH TO ISOKINETIC NULL PROBE DESIGN. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1972. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-32.)

A null probe of radical new design for sampling isokinetically the particle-laden gas stream in particulate sampling operations is discussed. The design eliminates the main problem encountered in previous models, that being the accurate measurement of static pressure. In the new probe, a small static probe is located in the center of the nozzle and another on the outside and the static taps of both tubes are located in the plane of the probe inlet. This ensures that static pressure changes which occur inside and outside the probe due to the disruption of fluid flow by the probe itself will not affect the sampling rate accuracy. A consideration of fluid theory shows why previous designs have met with limited success and why the new design overcomes these deficiencies. A prototype was constructed and tested in both a wind tunnel and a field sampling situation. Performance was excellent in both circumstances, with errors generally less than 5%. It is believed that the errors were due to poor instrument precision rather than design inadequacies. (Author abstract modified)

42980

Gussman, Robert A., Anthony M. Sacco, and Roger E. Ladd

DESIGN AND CALIBRATION OF A HIGH VOLUME CASCADE IMPACTOR. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1972. 13 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-27.)

An air sampler capable of classifying large quantities of airborne particulate matter into discrete size fractions was developed. Such a fractionation will permit discrete size-related chemical analysis of various particulate pollutants and a more realistic assessment of their health effects. A 20 cu ft/min, five-stage cascade impactor of the slit-type was constructed and calibrated. The calibration aerosol consisted of six different sizes 1.35-14 micron of isodispersed methylene blue produced with a spinning disk generator. The calibration was challenged with heterodispersed aerosols of methylene blue, Arizona road dust, and dioctyl phthalate. Test and calibration results are tabulated. (Author abstract modified)

41288

Burton, Robert M., James N. Howard, Robert L. Penley, Peggy A. Ramsey, and Thomas A. Clark

FIELD EVALUATION OF THE HIGH-VOLUME PARTICLE FRACTIONATING CASCADE IMPACTOR: A TECHNIQUE FOR RESPIRABLE SAMPLING. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1972. 10 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972.)

A four-stage, multiorifice, high-volume fractionating cascade impactor with backup filter, which can be operated as a component of the standard Hi-Vol sampler, separates particulate matter into five aerodynamic size ranges: 7 micron or larger; 3.3-7 micron; 2.0-3.3 micron; 1.1-2.0 micron; and 0.01-1.1 micron. Field tests utilizing duplicate sampling techniques in comparative tests were conducted to determine the feasibility of using the fractionator on a routine basis in field operations. A glass fiber collection medium with a pH of 11.0 absorbed atmospheric acid gases during sampling and should not be used if results comparable to those obtained with the standard Hi-Vol sampler are desired. Glass fiber filters with a pH of 6.5 will eliminate the acid gas absorption. (Author abstract modified)

44709

Wilson, E. F., L. Himmelstein, and F. P. Hauptman

CONTINUOUS PARTICULATE MEASUREMENTS IN PHILADELPHIA, PENNSYLVANIA: A ONE YEAR STUDY OF THE INTEGRATING NEPHELOMETER. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1972. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-23.)

A continuous particulate measuring instrument was needed to adapt to a new telemetered air monitoring system. The integrating nephelometer was evaluated for this purpose. A brief description of the instrument is presented along with some theory of how the light-scattering coefficient relates mathematically to the suspended-dust level. Correlation coefficient and regression equations were developed using Philadelphia particulate data collected over a 13-month period from an integrating nephelometer and high-volume air samplers. The data show that a correlation coefficient of 0.7-0.8 is about as good as can be expected in urban air containing a wide range of particle sizes. The best expected particulate concentration estimate appears to be about plus or minus 30 micrograms/cu m because the high-volume air sampler filter captures particles ranging up to 100 times the size of particles having the highest scattering coefficient. However, the smaller particles measured best by the integrating nephelometer are known to be potentially dangerous since they enter into the deep areas of the lung. (Author abstract modified)

44757

Findley, Charles E. and August T. Rossano, Jr.

CONTINUOUS MONITORING OF PARTICULATE MATTER IN AUTOMOBILE EXHAUST. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1972. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-67.)

The design and testing of a continuous monitoring system using a nephelometer for the measurement of primary automobile exhaust particulate concentration are described. The system is based on the relationship of particle light scattering and mass concentration. Twenty separate tests were conducted with two automobiles over a 5-week period of time. Measurements of the light-scattering coefficient and mass concentration were made while the vehicles were idling. The relationship between these two variables was investigated by using a linear regression analysis. A good correlation of light-scattering and mass concentration for the range of test values covered was found as evidenced by correlation coefficients of 0.930 and 0.705 for the two test vehicles used in the study. The mean of the constant of proportionality (K) relating the ratio of particle mass concentration to light scattering coefficient was 6,100,000 micrograms/sq m with a 95% confidence level interval of 5,400,000 to 6,800,000 micrograms/sq m. For the range of test values covered, small variations in mass concentration produced wide variations in the light scattering coefficients. A high repeatability of both mass concentration and light scattering data was indicated by the tests. Size distribution tests were conducted on the exhaust gas from one of the test vehicles utilizing a membrane filter and cascade impactor. About 99% of all particles collected had a smaller than 0.5 micron mass median diameter. The remaining 1% had a larger than 15 micron mass median diameter. (Author abstract modified)

44803

Morrow, Stephen W. and Patrick R. Atkins

APPLICATION OF AUTOMATIC CONTROL TO THE PROBLEM OF ISOKINETIC STACK SAMPLING. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 26p., 1972. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-66.)

In order to apply automatic control to any physical system, suitable variables must be available which are descriptive of the behavior to be controlled. In the case of stack sampling, variables must be available which indicate how and when sampling velocity must be varied to maintain the isokinetic situation. The null-type nozzle has been utilized manually to achieve isokinetic conditions, and could be readily adapted to automatic control. This device operates upon the premise that at isokinetic conditions, static pressure within the probe will be equal to duct static pressure. These two pressures are balanced on a manometer, the zero deflection or null point indicating isokinetic conditions. Unfortunately, the operating principle of the null-type nozzle is valid only for inviscid flow. In reality, static pressure within the probe will be less than duct static pressure at isokinetic sampling velocities, due to frictional losses and kinetic energy changes. However, if this deviation from the null can be quantified, static pressure inside the probe minus duct static pressure could be used as an input signal to a control circuit designed to achieve the isokinetic condition. Theoretical and experimental predictions of this deviation from null at isokinetic conditions is described. Adaptation of this input to a control circuit is also discussed. The value of static pressure inside the probe minus duct static pressure is a feasible input to a control circuit designed to achieve and maintain the isokinetic condition. (Author abstract)

44873

Ivey, Lee R.

TOOLS FOR EVALUATING NEW PROCESS AND CONTROL PLANS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 21p., 1972. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., 1972, Paper 72-40.)

Tools used to evaluate quantitatively certain aspects of air pollution control devices utilized in industrial plants are presented. A chart for measuring the effectiveness of incinerator afterburners and vapor incinerators requires as inputs the rate of flue gas flow in standard cu ft/min and the auxiliary fuel burner capacity in Btu per hour. The chart yields the flue gas temperature increase, given in degrees Fahrenheit, which will result. A second tool is a new psychrometric graph for the humidification and cooling of gases from processes as hot as 3000 F. Inputs into the graph are the temperature of the gases entering the sprays from the hot process and the temperature desired before they enter a control device such as a fabric filter or a scrubber. The yield is the amount of water needed in gallons/1000 cu ft of gas. The only calculation needed is a correction of the hot gas volume to 70 F. Research areas discussed are solid particles removal after wetting and the use of surface active agents in scrubbing gaseous pollutants. There is every indication that surfactants would markedly increase the rate of organic vapor adsorption on liquid surfaces. The possible importance of this adsorption phenomenon to air pollution control is highlighted, particularly in view of the dwindling natural gas supply. (Author abstract modified)

[illegible]

Jackson, Melbourne L.

PARTICLE-MOLECULE COLLECTION BY SONIC FLOW IMPINGERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 11p., 1972. 10 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-6.)

A convenient, inexpensive, and sufficiently accurate method of sampling molecular and near micron and submicron particles, is described. Utilization of two sonic flow impingers in a series is predicted to collect 98 to 99% of a phosphoric acid aerosol having a mass median diameter of 0.7 micron. The first impinger simultaneously collected 90 to 96% of the aerosol and 99% of molecular fluoride compounds in a field test. On the same aerosol, the standard Greenburg-Smith impinger had a low collection performance, less than 65% at sonic velocity. The utilization of a first impinger at sonic flow greatly simplifies sampling procedures by the need for a test meter and associated pressure and temperature measurements. Also, for small particle sizes, isokinetic sampling is not necessary, and sampling line losses by deposition are less than 1%. The low initial cost of the sampling units and the low manpower requirements for setting up and supervising sampling make possible the taking of a number of samples sufficient to establish emissions over extended intervals of time. The equipment is especially suited to locations having multiple emission sources, or for locations requiring simultaneous sampling of many points. (Author abstract modified)

48177

Luke, Connell L., Thomas Y. Kometani, John E. Kessler, Thomas C. Loomis, John L. Bove, and Benjamin Nathanson

X-RAY SPECTROMETRIC ANALYSIS OF AIR POLLUTION DUST. Environ. Sci. Technol., 6(13):1105-1109, Dec. 1972. 7 refs.

Direct nondestructive analysis of airborne particulate matter for common metals using X-ray fluorescence spectrometry was examined. Commercially available instrumentation was used for the direct determination of lead, zinc, copper, nickel, iron, manganese, and cobalt in samples collected on filter paper. Calibration was achieved by precipitating known amounts of these elements and collecting them on a Millipore filter disc which serves as a reasonably permanent standard. (Author abstract modified)

[illegible]

Nader, John S.

DEVELOPMENTS IN SAMPLING AND ANALYSIS INSTRUMENTATION FOR STATIONARY SOURCES. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., National Environmental Research Center, 15p., 1972. 7 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 13th, Berkeley, Calif., Oct. 30-31, 1972.)

Developments in measurement, sampling, and analysis instrumentation for stationary sources are discussed. Instrumentation for the measurement of pollutant emissions from stationary sources is best considered in terms of a complete system consisting of subsystems having interdependent functions, including sample site selection, sample transport, sample treatment, sample analysis, data reduction and display, and data interpretation. Five measurement approaches exist, two of which involve sample extraction from within the stack. The remaining three are advanced techniques using electro-optical techniques, including in-situ monitoring, remote sensing, and long-path sensing. Current development status of instrumentation for each approach was categorized as systems commercially available, research or prototype development, and feasibility studies. The incompleteness of a measurement system is caused by the lack or inadequacy of an interface to couple a monitor to a source. This applies to the two approaches that involve sample extraction and that predominate as commercially available products. New systems using advanced electro-optical techniques avoid the need for sample extraction and the complications associated with the interface functions.

[illegible]

Bird, Alvin N., Jr. and Joseph D. McCain

PARTICULATE SIZING TECHNIQUES FOR CONTROL DEVICE EVALUATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1973. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-283.)

Measurement of the concentration and distribution of particles smaller than about 3 micron is necessary for assessing the potential contributions of particulate emission sources to long term atmospheric turbidity problems and human respiratory effects. To design and apply control equipment effectively, information on mass loading as a function of particle size is needed for the small particles (e.g., 0.2 to 3 micron in diameter). Field and laboratory tests were conducted to evaluate inertial sizing techniques, cascade impactors, and cyclones for field measurements of control device efficiency as a function of particle size. Over 100 particle size distribution measurements were made with 11 inertial classifiers on 17 stationary emission sources. No single inertial sizing device was suitable for all the sampling circumstances encountered on a wide variety of stationary emission sources. Further, reliable measurements of mass loading as a function of particle size for sizes below about 1 micron required a sample weighing accuracy of at least 50 micrograms, and 10-microgram accuracy was desirable. To achieve this accuracy in the field, it was necessary to use low-tar-weight (10 to 500 mg) impaction substrates (e.g., metal foil or glass fiber filter material.) (Author abstract modified)

[illegible]

Gilfrich, J. V., P. G. Burkhalter, and L. S. Birks

X-RAY SPECTROMETRY FOR PARTICULATE AIR POLLUTION–A QUANTITATIVE COMPARISON OF TECHNIQUES. Anal. Chem., 45(12):2002-2009, Oct. 1973. 17 refs.

A quantitative comparison of the X-ray spectrometry technique for particulate air pollution was made. X-ray fluorescence spectrometry is best suited to the determination of the elemental composition of air pollution particulate samples because no sample preparation is required for filter collections and 100 sec detection limits are 1 to 100 ng/sq cm for most elements of interest. The technique is nondestructive, and 15 or 20 elements can be measured simultaneously using presently available commercial equipment. The best detection limits are achieved by reducing the background primary radiation scattered into the measuring system by the sample and its filter substrate. Comparisons were made among various excitation sources, X-ray tubes, fluorescers, radioisotopes, and 5-MeV protons, and alpha particles, and between wavelength dispersion using a crystal spectrometer and energy dispersion using a silicon (lithium) solid state detector. Incinerator and other actual samples were analyzed to show application of the method. (Author abstract modified)

16790

Lundgren, Dale A. and Harold J. Paulus

THE MASS DISTRIBUTION OF LARGE ATMOSPHERIC PARTICLES, AND HOW IT RELATES TO WHAT A HIGH-VOLUME SAMPLER COLLECTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1973. 8 refs. (Presented at the Air Pollution Control Association Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-163.)

Determinations were made of the total mass and mass distribution of atmospheric aerosols, especially those with particles greater than 10 micron in diameter, the fraction of total aerosol mass collected by a standard high-volume air sampler, and the size interval settled out on a dust fall plate. A special aerosol sampling system was designed to obtain representative samples of large airborne particles, and a suburban sampling site was selected because no strong local point sources of aerosols existed nearby. Measurements indicated that atmospheric particulate matter has a bimodal mass distribution; mass associated with large particles mainly ranged from 1-100 micron, while that associated with small particles ranged from an estimated 0.01-1 micron in size. These two distributions produced a bimodal mass distribution with a minimum around 1 micron diameter. The high volume air sampler was found to collect most of the total aerosol mass, while dust fall plates did not provide a very useful measure of total aerosol mass. Condensation and dispersion appeared to account for the formation of the bimodal mass distribution in both natural and anthropogenic aerosols. Particle size distribution measurements were found frequently in error as a result of unrepresentative samples of large airborne particles. Hence, air pollution regulations should specify or be based upon an upper particle size limit. (Author abstract modified)

17130

Alkezweeny, A. J.

A SYSTEM FOR MEASURING PARTICLE SIZE DISTRIBUTIONS. In: Pacific Northwest Laboratory Annual Report for 1972 to the USAEC Division of Biomedical and Environmental Research. Volume II: Physical Sciences. Part 1. Atmospheric Sciences. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., p. 140-142, April 1973. 1 ref. NTIS: BNWL-1751 PT1, UC-53 Meteorology.

A modified Royco particle counting system is described which is capable of simultaneously measuring the concentration and size distribution of particles in the size range of 0.3-3 micron diameter in about 100 channels. The aerosol particles are drawn into a Royco Model 220 optical sensor, and the 90-degree light scattering from the individual particles is detected by photomultiplier tube and preamplifier, in the form of a voltage pulse. Calibration and instrumentation are described. (Author abstract modified)

18115

Crocker, B. B.

MONITORING PLANT AIR POLLUTION. Chem. Eng. Progr., 70(1):41-49, Jan. 1974. 17 refs.

Measuring methods, instrumentation, costs, and applications are outlined for industrial process, effluent, and area monitoring of gases and particulates. Illustrations are provided for a sampling system with a remote monitor, a 24-hour daily composite gas sampling system, a typical sequential sampler, a dilution scheme for continuous stack gas sampling, a Barringer in-stack sulfur dioxide monitor, a Paristor and electronic indicator, a Bailey stack opacity meter, a Lear Siegler opacity monitor, a particulate mass monitor using beta-ray attenuation, and a Lear Siegler beta-ray attenuation particulate monitor with traversing sample probe. Typical ambient air concentration continuously monitored which can be used for stack effluent analysis with dilution are listed for: sulfur dioxide, total sulfur oxides, hydrogen sulfide, oxides of nitrogen, carbon monoxide, oxidants such as ozone, and hydrocarbons such as methane.

18173

Cunningham, Paul T., Stanley A. Johnson, and Ralph T. Yang

VARIATIONS IN CHEMISTRY OF AIRBORNE PARTICULATE MATERIAL WITH PARTICLE SIZE AND TIME. Environ. Sci. Technol., 8(2):131-135, Feb. 1974. 27 refs.

Samples of airborne particulate material were classified with respect to particle size and time during their collection by inertial impaction, and infrared spectroscopic analysis was used to measure the major chemical constituents of the samples. Data obtained clearly indicated that the particulate material collected contained ammonium sulfate, ammonium halide, carbonate, silicate, silica, nitrate, hydrocarbon, and chemisorbed nitrogen dioxide (surface nitrate). The results also showed variations in the chemistry of airborne particulates as a function of particle size and time and supported recent theories on the origin of particulates that have been based on size distribution measurements and may be important in assessing the potential health hazard of particulates as well as the appropriateness of control techniques. (Author abstract modified)

18180

Bigg, E. K., A. Ono, and Judith A. Williams

CHEMICAL TESTS FOR INDIVIDUAL SUBMICRON AEROSOL PARTICLES. Atmos. Environ., 8(1):1-13, Jan. 1974. 17 refs.

A thin film vapor method for the detection of aerosol particles of masses down to 10 to the minus 16 g or less is described. Particles are captured on electron microscope screens precoated by vacuum evaporation with a thin film of reagent, and the reaction proceeds by exposure to the vapor of a suitable solvent. The reaction products are then examined with an electron microscope and compared with similar particles captured on a non-reactive surface such as carbon. The method is capable of detecting a radical such as sulfate in a particle of very small size and allows for a large spreading of the original particle, thus making possible the use of an electron microscope at low magnifications for examination of a large area at one time. Examples are provided for the detection of sulfuric acid, sulfates, nitrates, halides, and persulfates in laboratory, urban, and stratospheric aerosols. (Author abstract modified)

18401

Hanel, Gottfried and Gode Gravenhorst

JET IMPACTOR CHARACTERISTICS VERSUS RELATIVE HUMIDITY. J. Aerosol Sci., 5(1):47-54, Jan. 1974. 13 refs.

Increased relative humidity can increase particle size and thus affect the collection of aerosols by jet impactors. For six types of continental and marine aerosols, the cut-off radius and the number of particles collected within a jet impactor were calculated as a function of relative humidity. The six aerosol types were an average aerosol from Mainz, Germany, a sea-spray aerosol, aerosol over the Atlantic, aerosol from Sahara dust over the Atlantic, urban aerosol from Mainz, and aerosol at a mountain in Germany. The calculations were performed for a three-stage impactor and for several heights above the mean sea level. An increase of the cut-off radius occurred on approximately a factor of 1.5-3 with a relative humidity between 0 and 0.985. For each stage, the number of collected particles per cu m of ambient air was not influenced severely, as long as the relative humidity was below 0.7. At larger humidities, this number increased strongly with relative humidity in most cases. The theoretical basis for the calculations was the implicit formula for the appropriate inertia parameter which is closely related with the probability of a particle being collected. (Author abstract modified)

18541

Matteson, Michael J., George F. Boscoe, and Othmar Preining

DESIGN THEORY AND CALIBRATION OF A FIELD TYPE AEROSOL SPECTROMETER. J. Aerosol Sci., 5(1):71-79, Jan. 1974. 15 refs.

A cylindrical-type aerosol spectrometer, of simple, compact design, was constructed and tested. The aerosol particles are injected into a horizontal centrifugal field through two ports – a pin-hole orifice situated opposite a larger port. Aerosols moving through the larger port are removed in a cumulative size deposition on half of a foil on the outer wall, and serve as clean air for aerosols injected through the pin-hole and deposited according to discrete sizes on the other half of the foil. The instrument is based on a modification of a device developed by Hochrainer and offers the advantage of confining the aerosol deposit to a narrow streak or dot in the case of monodisperse particles. The spectrometer was calibrated with monodisperse polystyrene latex particles. The results were compared with a theoretical expression developed for sedimentation distances appropriate to aerosols flowing in the plane of rotation. The pressure drop across the exit orifice could be calculated from design variables, and, assuming that the aerosol volumetric flow rate in the annular channel was limited by the pressure drop across the exit orifice, this flow rate was obtained from orifice calibration data. Satisfactory agreement was found between theoretically predicted sedimentation distances and those from tests with aerosols of polystyrene latex. (Author abstract modified)

18811

Renoux, A., G. Tymen, and G. Madelaine

EXPERIMENTAL DETERMINATION OF THE CHARACTERISTICS OF THE CASELLA MK2 CASCADE IMPACTOR; APPLICATION TO THE STUDY OF THE GRANULOMETRIC DISTRIBUTION OF AEROSOLS AND OF ATMOSPHERIC RADIOACTIVITY. Atmos. Environ., 8(1):41-55, Jan. 1974. 20 refs.

The different characteristic diameters (cut-off size, effective cut-off size, mass median diameter, and effective cut-off diameter) of a Casella MK2 cascade impactor were experimentally determined by tracing the penetration curves of the apparatus. On the second and third discs the distribution of dust is log normal. Evaluating the law of granulometric distribution of aerosols, i.e., dN/d log(R) equals CR to the minus B power gives the solution B equals 3.3 for 0.2 micron is less than R is less than 2 micron; B equals 3.4 for 2 micron is less than 20 micron; and B equals 6.7 for R greater than 20 micron. The experimental values of the mean mass diameter and the effective cut-off diameter measured for each stage of the cascade impactor are used to correct the cumulated distribution curves of the mass and of the natural radioactivity of the atmospheric aerosols. (Author abstract)

10680

Seeley, J. L. and R. K. Skogerboe

COMBINED SAMPLING-ANALYSIS METHOD FOR THE DETERMINATION OF TRACE ELEMENTS IN ATMOSPHERIC PARTICULATES. Anal. Chem., 46(3):415-421, March 1974. 32 refs.

A combined sampling-analysis method for the determination of trace elements in atmospheric particulates has been developed which utilizes spectroscopic graphite electrodes as filters and direct analysis by an emission spectrographic method. The graphite filters used were porous cup spectrographic electrodes (Ultra Carbon, No. 303) which were solution-doped with 0.25 micrograms of indium as an internal standard. Ineffective vaporization of elements deposited in the lower half of the collection cups was overcome by a vaporization approach whereby argon entered the bottom of an electrode cup which was essentially saturated with hydrogen chloride vapor. The graphite cup filters appeared to be more effective for particulate collection than the more commonly used types, and the low blank of the graphite filters readily permitted determinations on small (short-term collection) samples or in low particulate background atmospheres. The method was found capable of determining several trace elements distributed in the atmosphere as particulates at concentrations of less than 0.1 micrograms/cu m (based on a 30 min sample collection) at a collection rate of 1 l/min. The emission spectrographic method allowed simultaneous determination of several elements on a single sample over a wide concentration range with precision and accuracy of 10-20% of the amount present.

14811

Cooper, Douglas W. and Lloyd A. Spielman

A NEW PARTICLE SIZE CLASSIFIER: VARIABLE-SLIT IMPACTOR WITH PHOTO-COUNTING. Atmos. Environ., 8(3):221-232, March 1974. 30 refs.

A novel instrument for measuring aerosol particle size distributions is described. The device exploits inertial impaction for a useful measure of particle size and photo detection for speed for particle counting. Upon fixing the angles of the surfaces bounding the two-dimensional air flow, the geometry is self-similar at all settings of the variable jet width; moreover, at fixed volume flow rate, the jet Reynolds number is fixed. Dynamic and geometric similarity then implies that impaction efficiency depends on a single dimensionless group, the Stokes number, which under certain conditions is proportional to the ratio of particle radius to jet width; thus, calibration for all particle sizes is accomplished simply by varying the jet width using a single particle size. Tests using monodisperse latex particles confirmed the expected scaling features and showed that decreasing the angle between plate and impaction surface improved size discrimination. The advantages of the new impactor are its rapidity, flexibility, continuously adjustable size intervals, and ease of calibration. The impactor and photocounter can size particles having aerodynamic diameters ranging from 0.7 to 3.10 micron. (Author abstract modified)

04276

West, Philip W., A. D. Shendrikar, and Nicholas Herrera

THE DETERMINATION OF SULFURIC ACID AEROSOLS. Anal. Chim. Acta, 69(1):111-116, March 1974. 13 refs.

A reliable, sensitive, colorimetric method for the determination of sulfuric acid aerosol and alternately the determination of total acidity, including sulfuric acid, volatile acids, and salts that hydrolyze to give protons is presented. The determinations can be performed directly on air samples collected with a sequential tape sampler, and use is made of the inexpensive ring oven for separating and concentrating the samples and reaction products. The basic chemical reactions involved are specifically controlled by protons: stoichiometric amounts of bromine are released from a mixture of bromate-bromide by the protons, and the liberated bromine reacts with fluorescein to produce eosin, the color intensity of which is a direct measure of proton concentration. The detection limit in terms of sulfuric acid is 0.1 microgram with a quantitative measurement range of 1-10 microgram. Relative errors are in the range of 10-15%, comparing favorably with sophisticated and expensive methods at the microgram or nanogram levels. (Author summary modified)

60291

Charlson, R. J., A. H. Vanderpol, D. S. Covert, A. P. Waggoner, and N. C. Ahlquist

SULFURIC ACID-AMMONIUM SULFATE AEROSOL: OPTICAL DETECTION IN THE ST. LOUIS REGION. Science, 184(4133):156-158, April 12, 1974. 13 refs.

Hygrometric sensing of the deliquescence of ammonium sulfate produced by the reaction of sulfuric acid or ammonium bisulfate aerosol with ammonia provides a means for detecting these substances in the air. The basic measurement apparatus is a humidograph which measures the dependence of the light scattering coefficient of the particulate matter on the relative humidity. The system can be operated with the injection of a few ppm of ammonia into the sample flow, causing the reaction of H_2SO_4 and NH_4HSO_4 to form $(NH_4)_2SO_4$. Field experiments showed these to be dominant substances in the submicron, light-scattering aerosol in the St. Louis region. The system was operated at one rural and two urban sites in St. Louis. It seemed likely that human sources of sulfur dioxide were the dominant source of sulfate aerosol. (Author abstract modified)

60381

Gordon, Robert J.

SOLVENT SELECTION IN EXTRACTION OF AIRBORNE PARTICULATE MATTER. Atmos. Environ., 8(2):189-191, Feb. 1974. 7 refs.

Replicate samples of airborne particulate matter were extracted with 17 different solvents, and the yields of dried extract appeared strongly correlated with the solvent strength parameter, derived from liquid-solid chromatography, for cases not involving a specific chemical interaction. Solvents with strength parameter values of 0.3 or larger, e.g., benzene (0.32), were adequate for recovery of polynuclear aromatic hydrocarbons. Solvents with higher solvent strength parameter values extracted larger amounts of highly polar organics although they also dissolved some of the more soluble inorganics. Soxhlet extraction occurred at elevated temperatures depending on the solvent boiling point, higher boiling solvents being more efficient than expected from their solvent strength values. Minor reversals in solvent strength parameter values were noted from one adsorbent to another.

63411

Brachaczek, Wanda and W. R. Pierson

ANALYTICAL METHOD FOR MEASURING SBR TIRE DEBRIS IN THE ENVIRONMENT. Rubber Chem. Technol., 47(1):150-160, March 1974. 4 refs.

An analytical method was developed for measuring suspended particulates collected on filters and analyzing them for rubber particles from rubber tire wear. The procedure consists of determining styrene-butadiene rubber (SBR) by measurement of the absorbance in the infrared spectrum at 10.35 and 14.3 micron. Large samples, quite opaque to infrared radiation, must be collected in order to obtain a detectable amount of SBR in the air. This necessitates a separation of SBR from the bulk of the material prior to measurement. The amounts of SBR to be separated are commonly in the submilligram range, constituting perhaps 0.1% of the sample. The method used for separation is extraction with hot orthodichlorobenzene in an oxygen-rich environment. Then the rubber hydrocarbon styrene-butadiene copolymer is analyzed by infrared spectroscopy in the extract. The procedure overcomes serious difficulties due to the small amounts of rubber normally encountered and due to the losses of SBR during extraction from aerosol samples. The method and some applications are discussed in detail.

62549

Lee, Robert E., Jr. and Jack Hein

METHOD FOR THE DETERMINATION OF CARBON, HYDROGEN, AND NITROGEN IN SIZE FRACTIONATED ATMOSPHERIC PARTICULATE MATTER. Anal. Chem., 46(7):931-933, June 1974. 9 refs.

A technique for characterizing carbon, hydrogen, and nitrogen constituents in atmospheric particulate matter as a function of particle size is described. The technique was applied to a limited number of cascade impactor samples collected in Ankara, Turkey, London, and Chicago. Ankara exhibited the highest concentrations of total suspended particulates (TSP), C, and H_2. No clear pattern was associated with the concentration of N_2. In all areas the mass median diameter of C and H_2 associated particles was generally larger than for TSP matter. The N_2 containing particles generally exhibited mass median diameter values lower than for TSP and may have a predominantly biological origin. Fuel combustion appears to be a substantial factor in the percentage of C in airborne particles with the highest levels observed in Ankara where lignite coal is the predominant fuel. An estimate of the degree of saturation of hydrocarbon compounds in suspended particles as a function of size can be made by calculating the C:H molar ratio although the contribution of carbonates is not taken into account.

62505

Johnson, Jack L.

CHARACTERIZATION OF AIR-BORNE PARTICULATES. Microchem. J., 19(2):168-178, June 1974. 26 refs. (Presented at the International Symposium on Microchemical Techniques, University Park, Pa., Aug. 19-24, 1973.)

Reliable instrument and chemical analysis techniques are being applied to the rapid and accurate characterization of airborne particulates including microanalysis, structure identification, and quantitative elemental analysis. Microanalytical techniques include optical microscopy, scanning electron microscopy, and electron probe microanalysis. X-ray diffraction provides valuable information on the structure of crystalline materials which can lead to compound identification. This identification is accomplished by comparing the diffraction patterns with powder diffraction data. Methods for quantitative analysis of particles include X-ray fluorescence, atomic absorption spectrophotometry, and ultraviolet-visible-infrared spectrophotometry. The choice of the method is governed by the amount and type of sample and by the elements of interest. Most of the problems associated with the analyses can be overcome with proper sampling, sample handling, and the development of suitable standards. Future improvements will be undoubtedly directed towards increased analytical sensitivity because the sample size will become smaller as the concentrations of pollutants decrease with improved emissions control. (Author summary modified)

62811

Miller, R., J. H. Kozak, and H. W. De Koning

ORIENTATION EFFECT OF GLASS FIBER FILTERS ON TOTAL SUSPENDED PARTICULATE MEASUREMENTS. Atmos. Environ., 8(5):519-520, May 1974. 2 refs.

A comparative study, using three hi-vol samplers, was run in Windsor, Ontario to determine the effect of glass fiber filter orientation (rough side up or down) on total suspended particulate measurements. Normally the filters are run rough side up. Three samplers were positioned within the fenced-in area of the air pollution monitoring station located at the intersection of Mill and Peter Streets, Windsor. The samplers were run on a 24-hour period starting at midnight. The first sampler was run with the filter installed in a normal position, the other two were equipped with filters in the upside down position. The samplers were calibrated using a calibrating orifice assembly. The glass fiber filters were weighed after conditioning in a humidity-controlled atmosphere for 24 hr, before and after sampling. The study revealed that the orientation of the glass fiber filters does not affect the measurement of total suspended [illegible] matter under conditions normally employed [illegible] vol sampler.

63783

Neustadter, Harold E. and Steven M. Sidik

ON EVALUATING COMPLIANCE WITH AIR POLLUTION LEVELS NOT TO BE EXCEEDED MORE THAN ONCE A YEAR. J. Air Pollution Control Assoc., 24(6):559-563, June 1974. 11 refs.

The recommended sampling frequency for meeting the Environmental Protection Agency air quality standards is discussed. A critique is presented of the calculation procedures for estimating the corresponding ambient pollution level when a sampling program is operating in conformity with EPA guidelines, once every 6 days. Quantitative consideration is given to the questions of statistical independence of the data, commutativity of expectation and exponentiation operations, and the statistical variability of the calculated results. Monte Carlo simulations were performed which indicate a 95% confidence interval of + or - 56% at 60 samples/yr and + or - 40% at 120 samples/yr. Sampling frequencies every third to sixth day are inadequate for determining conformity with standards expressed as levels not to be exceeded more than once per year. (Author abstract modified)

63839

Sugimae, Akiyoshi

EMISSION SPECTROGRAPHIC DETERMINATION OF TRACE ELEMENTS IN AIRBORNE PARTICULATE MATTER. Anal. Chem., 46(9):1123-1128, July 1974. 18 refs.

An emission spectrographic method was used for the determination of trace elements in airborne particulate matter collected on a membrane filter. The membrane filter was dissolved in acetone, and the airborne particulate matter separated from the filter. After centrifuging, the powder obtained was washed three times with acetone, dried, and mixed with sodium fluoride and graphite powder. The resulting mixture was packed in a graphite cup electrode and excited by a dc arc. Sodium was selected as the spectroscopic buffer to normalize variations in sodium concentration in the samples. Elements such as bismuth, cadmium, lead, tin, and zinc, classified in the volatile element group, were totally volatilized in the first 30 sec of the discharge. The volatilization of beryllium, chromium, copper, manganese, titanium, and vanadium which were divided into the volatility groups of the medium volatile or involatile, tended to delay and continued more than 100 sec. The selection of internal reference elements was based upon the similarity of volatilization rates for elements, which fell into two distinct groups. To check the accuracy of the method, the results of atomic absorption analyses were compared with those of emission spectrographic analyses. There was good agreement between the two methods. The relative standard deviation was 13% or less, values which are generally acceptable for most air pollution analysis requirements.

64361

Countess, Richard J.

PRODUCTION OF AEROSOL BY HIGH VOLUME SAMPLERS. J. Air Pollution Control Assoc., 24(6):605, June 1974. 3 refs.

The Staplex high volume sampler, widely used for atmospheric monitoring, produces carbon aerosol by the abrasive wear of its motor brushes. The aerosol is entrained in air flowing past the motor and is discharged from the rear of the sampler casing. This does not interfere with the use of the Staplex in measurements of a specific contaminant, but might interfere with measurements of total dust load. Therefore, measurements were made of the amount of aerosol produced by the sampler and of the fraction of aerosol that recirculates to the sampler inlet. Recirculation was very low at all conditions tested and did not exceed 0.1%. A carbon aerosol concentration of no more than 0.1% of 150 or 0.15 micrograms/cu m would recirculate in normal circumstances. This can be ignored, for environmental mass dust concentrations are rarely less than a few micrograms/cu m, even in rural areas. But there is a need for caution in some situations in view of the substantial concentration of carbon aerosol produced by the Staplex or other pumps using a centrifugal blower motor with carbon brushes.

64876

Winkler, Peter

RELATIVE HUMIDITY AND THE ADHESION OF ATMOSPHERIC PARTICLES TO THE PLATES OF IMPACTORS. J. Aerosol Sci., 5(3):235-240, 1974. 10 refs.

Quantitative proof of the increased retention efficiency of humidified atmospheric aerosol particles is obtained in two series of experiments using impactors to collect the particles and a microbalance to determine the water free dry mass of aerosol collected. Results show that atmospheric aerosol particles can be collected by means of impactors with sufficiently high retention efficiency even without any viscous substrate on the collection plate if the relative humidity remains high enough (greater than 70%) during the sampling period. The absorbed water of the particles acts as an adhesive. This effect is further supported by the moisture of the particles already deposited which act like a viscous coating of the collection plate. With decreasing humidity (less than 70%) the retention efficiency of the collection plate decreases rapidly. At low r.h. (less than 70%) a change in the relative composition of the sample can occur due to a preferential deposition of the water soluble material. This can only happen if there are differences between the average composition of the total aerosol mass as indicated by the analysis of the bulk sample and the composition of the individual aerosol particles. Additional information would be desirable on the radius dependence of retention efficiency and more measurements would result in better statistics. A direct comparison of the humidity-dependent mass retention efficiency with the mass retention efficiency achieved by viscous media, would be of interest.

65304

Miller, Kenneth and Henk W. De Koning

PARTICLE SIZING INSTRUMENTATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1974. 9 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-88.)

Various particle size fractionators, including the Andersen Non-viable Air Sampler, the Hill Cascade Centripeter, the R. A. C. Fractionating Particulate Sampler, the Andersen, the Hill-50, and the Sierra Hi-volume Cascade Impactors, are evaluated. Ambient air monitoring of suspended particulates is undertaken to determine their size distribution and their effects on human health, visibility in the atmosphere, material deterioration, soiling, particle-particle, and particle-gas interactions. The data gathered also permitted the study of the following: precision of hi-volume samplers; effects of flow rate on accuracy of suspended particulate concentrations using hi-volume samplers; correlation of total suspended particulate measurements as determined by the hi-volume and the particle sizing instruments; comparison of the mass median diameter measured by the various impactors; and ease of operation and maintenance. A sampling station was constructed in a high particulate loading residential area in Windsor, Ontario. The samplers are positioned 2.5 to 3 feet apart, with intakes being approximately 4.5 to 5 feet above ground level. All samplers are operated on a 3-day sampling schedule. The hi-volume measurements obtained at the same flow are comparative. There is a significant effect of flow rate on total suspended particulate concentration. There is a significant sampler effect on total suspended particulate measurements and on mass median diameter. The Andersen, Hill-50, and Sierra hi-volume impactors can be used in place of the standard hi-vol for T. S. P. determinations if empirical relationships are developed. There is a definite requirement for research into the calibration and operation of particle fractionating instruments in the field. (Author abstract modified)

65329

Gruber, Charles W. and Gale Harms

FUGITIVE DUST MEASUREMENT BY THE ROTARY AMBIENT ADHESIVE IMPACTOR. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1974. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-95.)

A hand powered rotary ambient adhesive impactor (RAAI) for short time grab sampling of fugitive dusts from non-confined sources is evaluated. The RAAI uses a small diameter circular target (approx. 1/4 inch dia.) to capture plus 20 micron particles by spinning the sampler at a fixed r.p.m. The volume sampled is a function of number of revolutions. Evaluation of the sample is by counting or comparative measurement. Efficiency of the instrument is presented. The construction of the RAAI is described and actual field measurements are included. Duplicate tests show good agreement. Several sources were measured: an interstate highway, a downtown street location, fly ash settling pond from a utility station, an asphalt paving facility, a parking lot, and a citizen shaking out a rug. All samples were one minute. Results are reported as particles/sq cm/min, with some of the data converted to concentrations as particles/cu m. The method is applicable to evaluating fugitive dust from non-confined sources. (Author abstract modified)

65327

Benson, Arthur L., Philip L. Levins, Arthur A. Massucco, and James R. Valentine

DEVELOPMENT OF A HIGH-PURITY FILTER FOR HIGH-TEMPERATURE PARTICULATE SAMPLING AND ANALYSIS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 33p., 1974. 8 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th Denver, Colo., June 9-13, 1974, Paper 74-114.)

Particulate handsheet filters with satisfactory purity, efficiency, thermal stability, wet strength (about 1 lb/in.), and flexibility for analysis of particulates in gases up to 800 C were made with 99.5% silicon oxide microquartz fibers. Commercial production on a papermaking machine is currently being considered. Cost is estimated to be about $1.60/sq ft. Almost all purity requirements for optimum atomic absorption and flame emission spectrophotometric analysis for trace metals was achieved. The filters appear highly promising for X-ray fluorescence analysis, but should be further evaluated. Suitability of the filters for neutron activation analysis is uncertain and should also be further evaluated. Dioctyl phthalate (DOP) percent efficiencies of 99 to 99.9% were achieved by using fibers of various diameters. The filters are insensitive to humidity, inert to most acids and organic solvents, and slightly alkaline (pH 9-10). The strength and flexibility result from a novel combination alkali and 800 C heat treatment. The heat treatment also decreases extractable impurities and moisture sensitivity. (Author abstract modified)

65338

Soffian, Gerard and Peter R. Westlin

PARTICULATE EMISSIONS FROM APARTMENT HOUSE BOILERS AND INCINERATORS. Preprint, Air Pollution Control Assoc., Pittsburgh Pa., 27p., 1974. 13 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-187.)

An extensive number of tests were made using the Environmental Protection Agency's Method 5 stack sampling train to obtain emission factors for existing apartment house boilers and incinerators in the City of New York. In addition to calculating emission factors, stack emission data were examined to compare results of simultaneous emission tests and to compare the dry particulate catch of the sampling train with the total particulate catch which included the impinger catch. The data indicate that the amount of particulate captured in the impinger section of the sampling train is relatively constant and is independent of the amount of dry particulate catch found during boiler emission sampling. This possibly results from the absorption of sulfur dioxide in the impingers and the subsequent formation of relatively constant quantities of sulfuric acid. Comparison of simultaneous boiler tests indicated that the sampling train may be sensitive to variations in operating personnel, sampling conditions, and boiler operation. Tests of onsite incinerators indicate that previously published emission factors may be too high for well maintained and properly operated incinerators. (Author abstract modified)

65340

Lapson, W. F., H. Oshes, and D. B. Harris

THE DEVELOPMENT AND APPLICATION OF A HIGH VOLUME SAMPLING TRAIN FOR PARTICULATE MEASUREMENTS OF STATIONARY SOURCES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 30p., 1974. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-180.)

The development and application of a high volume sampling train for particulate measurements of stationary sources are described. The new train can be used at flow rates up to nearly 6 cfm, or at least six times the flow rate of the more conventional sampling train. The system can be unpacked and set up for use in a matter of minutes. The high volume sampling train was tested together with a standard sampling train under controlled conditions. The high volume train acquires a sample in about 1/4 the time of a standard sampling train. At grain loadings of 0.04 grains/cu ft and an effluent velocity of 60 fps, the high volume sampler can easily acquire the three samples required for Method 5 in a single day of testing. (Author abstract modified)

65141

Weitzman, Leo and John C. Reed

REVIEW OF PARTICULATE STACK TEST REPORTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1974. 7 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-194.)

The principles of a properly performed particulate stack test are discussed from the viewpoint of an individual reviewing the test report. A systematic analysis method is presented which allows calculation of the isokinetic ratios, pollutant mass emission rates, and other test parameters needed to determine whether the sampling was properly performed. A second worksheet is presented which enables the reviewer to determine the reliability of the test results in relation to applicable regulations. The calculations use the raw data and can be performed in approximately 1/2 hr with a slide rule or a square root function portable calculator. For stack test data on coal-fired boilers, the normal distribution is a realistic description of deviation from the measured mean of a test. (Author abstract modified)

66611

Liu, Y. H., V. A. Marple, K. T. Whitby, and N. J. Barsic

SIZE DISTRIBUTION MEASUREMENT OF AIRBORNE COAL DUST BY OPTICAL PARTICLE COUNTERS. Amer. Ind. Hyg. Assoc. J., 35(8):443-451, Aug. 1974. 16 refs.

An optical particle counter was calibrated for size distribution measurement of airborne coal dust particles. A differential electrical mobility analyzer was used with a fluidized bed dust feeder to produce uniform coal dust particles of a known size for calibration for particles less than 1.4 micron. For larger particles, the optical counter was calibrated with a microscopic technique. The output pulse height of the optical counter was significantly lower for coal particles than for spherical oil drops of the same particle size. The geometrical standard deviation of the output pulse height distribution of the optical counter for monodisperse aerosols increased from about 1.1 for spherical oil particles to about 1.6 for the irregularly shaped coal particles. Although this broadening effect reduced the ability of the counter to resolve small particle size differences, a numerical inversion procedure was developed which allowed the original size distribution to be recovered. Thus, the response of the optical particle counter to coal was significantly different from its response to ideal transparent spheres, but this can be properly corrected and systematic errors in the measurement size distribution eliminated by proper calibration and data reduction procedures. (Author abstract modified)

66621

Giauque, Robert D., Lilly Y. Goda, and Roberta B. Garrett

X-RAY INDUCED X-RAY FLUORESCENCE ANALYSIS OF SUSPENDED AIR PARTICULATE MATTER. Calif. Univ., Berkeley, Calif., Nuclear Chemistry Div., Atomic Energy Commission Contract W-7405-ENG-48, Rept. [illegible], 41p., July 1974. 16 refs. NTIS: LBL-2951

A theoretical review is presented on critical aspects of X-ray induced X-ray fluorescence analysis that should be considered for quantitative elemental analysis of suspended air particulate matter. Topics reviewed include: sensitivity factors involving selection of the excitation radiation, geometry considerations, spectrometer characteristics, and substrate selection; determination of relative excitation-detection efficiencies; and determination of particle size effects. A method is illustrated for compensating for particle size effects when analyzing for lower atomic number elements by assuming that the larger suspended particles are collected in the form of a monolayer. Although the procedure requires that a weighted average value for the average mass thickness be employed, the net error in the result is relatively small due to the fact that the bulk of the mass concentration is usually within a relatively small range since the total mass of a particle can vary as the cube of the particle diameter.

66626

Ettinger, H. J., M. I. Tillery, L. McGuire, and L. Ortiz

AEROSOL SIZE CHARACTERIZATION AND SAMPLING. In: Annual Report of the Biomedical and Environmental Research Program of the LASL Health Division, Jan. through Dec. 1973. California Univ., Los Alamos, N. Mex., Los Alamos Scientific Lab., Atomic Energy Commission Contract W-7405-ENG-36, Rept. LA-5633-PR, p. 35-37, May 1974. 1 ref. NTIS: LA-5633-PR

The spinning spiral channel aerosol size spectrometer for studying small airborne particulates and its performance are discussed. The advantages of an expanding channel spectrometer over the less expensive nonexpanding channel spectrometer are described theoretically. The equations will be solved by computer and compared with empirically derived calibration curves for the spectrometers to determine if the model is sufficiently representative. The equations do indicate that the expanding channel will require a greater length for deposition since the tip of the nonexpanding channel drives the particles into a region of high centrifugal force. This suggests that the simpler, nonexpanding design is preferable from both a cost and usefulness point of view. Air sampling in the vicinity of glove boxes to determine hazards to workers from containment system leaks is also discussed. Optimum sampler location determination procedures are reviewed. Membrane filters can be used to collect particles which are then viewed for size determination by optical microscopy. Submicron particles can be collected by electrostatic or thermal precipitation and sized by electron microscopes.

66631

Mark, D.

PROBLEMS ASSOCIATED WITH THE USE OF MEMBRANE FILTERS FOR DUST SAMPLING WHEN COMPOSITIONAL ANALYSIS IS REQUIRED. Ann. Occupational Hyg., 17(1):35-40, 1974. 3 refs.

Properties required of filter materials for use in the gravimetric sampling of airborne coal mine dust, when subsequent compositional analysis by infrared spectrophotometry is performed, are outlined, and results are presented from laboratory investigations with five types of membrane filters. Filter material characteristics required for gravimetric sampling of respirable mine dust for subsequent infrared analysis include: high collection efficiency (virtually 100%), minimal moisture effect, and negligible or predictable ash production which does not interfere in the infrared spectrogram for quartz. Test results are given for a Sartorius PVC filter, a Sartorius cellulose nitrate filter, two Gelman Metricel filters, a Millipore Polyvic filter, and a Whatman glass fiber filter (for comparison). All of the incinerated filter materials, with the exception of the Sartorius PVC filter which leaves no ash, show significant interference in the region of spectrogram corresponding to quartz peaks. The Sartorius PVC filter, however, appears to collect considerably less dust than the glass-fiber filters currently in use due to electrostatic repulsion of the dust particles by the filter during sampling. A method of treating the filters with a detergent solution appears to eliminate the under-sampling of the PVC filter, while apparently not resulting in any other adverse effect.

67811

Michel, H. V. and Frank Asaro

NEUTRON ACTIVATION ANALYSIS OF PARTICULATE MATTER IN AIR. In: Nuclear Chemistry Annual Report 1973. California Univ., Berkeley, Lawrence Berkeley Lab., Atomic Energy Commission Contract W-7405-eng-48, Rept. TID-4500-R61, UC-4, Chemistry, p. 407-409, 1974. NTIS: LBL-2366

Neutron activation analysis is performed on airborne particulate matter from the Pasadena, California area to determine modifications necessary for the conversion of analytical techniques developed for pottery analysis to the analysis of air pollutants. Measured weights and standard deviations are listed for the following elements: aluminum, magnesium, calcium, vanadium, chlorine, bromine, sodium, manganese, strontium, potassium, gallium, uranium, samarium, tungsten, cadmium, mercury, arsenic, titanium, tantalum, cobalt, scandium, silver, iron, cesium, antimony, tin, iridium, chromium, thorium, Eu, barium, nickel, rubidium, terbium, hafnium, zinc, and selenium.

67838

Hamil, Henry F. and David E. Camann

COLLABORATIVE STUDY OF METHOD FOR THE DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES (PORTLAND CEMENT PLANTS). Southwest Research Inst., San Antonio, Tex., Environmental Protection Agency Contract 68-02-0626, ROAP No. 26AAG, Program Element 1HA327, Rept. EPA-650/4-74-029, 38p., May 1974. 16 refs. NTIS: PB 237048/AS

The results of a collaborative test of the Environmental Protection Agency's Method 5 - Determination of Particulate Emissions from Stationary Sources are presented. The test was conducted by four participating laboratories at a Portland cement plant under simulated real world Method 5 testing conditions. Topics discussed include: the design of the collaborative test, problems encountered in using Method 5, estimates of the inter- and intra-laboratory precision of the method, sources of precision variability, and the necessity of sampling restrictions for compliance testing. The magnitude of the Method 5 precision estimates obtained is due primarily to occasional extremely high particulate determinations. This high value phenomenon, present in all three Method 5 collaborative tests conducted by Southwest Institute, is believed to be caused by accidental scraping of the probe tip against the stack wall. The following suggestions are made to improve the inter- and intra-laboratory precision of the method: develop a procedure to prevent, or at least inhibit, the occurrence of the high value phenomenon, standardize the method to reduce laboratory bias by specifying in greater detail how procedures are to be performed, and retain the isokinetic sampling restriction but with some latitude in the minimum dry gas sampling volume limitation.

[illegible]

Wedberg, George H., Kwok-Chi Chan, Bernard L. Cohen, and John O. Frohliger

X-RAY FLUORESCENCE STUDY OF ATMOSPHERIC PARTICULATES IN PITTSBURGH. Environ. Sci. Technol., 8(13):1090-1093, Dec. 1974. 10 refs.

Methods for determining whether air pollution episodes in Pittsburgh are due to industrial or automotive sources were investigated by trace element analysis of fine particulates using proton-induced X-ray fluorescence. The determination of the lead/bromine ratio was inadequate because Pb, as well as Br, is predominantly of automotive origin, and the ratio of these elements in particulates from auto exhaust varies with time and atmospheric conditions. The ratio of Pb to iron was much more useful, as Fe is almost exclusively of industrial origin. Several air pollution episodes in the Pittsburgh area were studied. Some were due to atmospheric stagnation with both Pb and Fe content high, while others were due to industrial emissions, characterized by low Pb/Fe ratios. (Author abstract modified)

[illegible]

Herrick, Robert A.

SOURCE SAMPLING FOR MASS EMISSIONS OF PARTICULATE MATTER: A STATE-OF-THE-ART REPORT. Health Lab. Sci., 11(4):264-270, Oct. 1974. 19 refs.

The state-of-the-art regarding the sampling of particulate matter, including in-stack concentrations, is reviewed. Although several established methods are available for measuring the particulate content of stack gases at stack conditions, there is no fully satisfactory source measurement since particulate matter is not adequately defined in terms of temperature and pressure specificity of the sampled stack gas. The Environmental Protection Agency's front half method is a specific method using arbitrary pressures and temperatures and is also a repeatable method which can be used to check emission levels against a numerical standard since it correlates directly with neither control equipment engineering data nor ambient air quality measurement. There are currently no fully adequate methods for measuring the condensible fraction of point source particulate emissions; the Greenburg-Smith impinger is unsatisfactory because of its low particulate collection efficiency in the sub-micron range and the possible absorption of gases. (Author summary modified)

[illegible]

Moskowski, S. R.

STACK PARTICULATE SAMPLING. Mech. Eng., 96(10):39-46, Oct. 1974. 6 refs.

In-stack particulate emission samplers has been used conveniently and successfully for a number of years, but have not received approval by the Environmental Protection Agency as an acceptable alternate for its own particulate sampling train procedure. Recent comparison tests are described which indicate that the in-stack samplers are more efficient, accurate, and consistent in actual practice than the EPA method. The efficiency of collection of the EPA system was erratic even under controlled conditions. For a series of checks it was below 90% by weight because of lay-down in the long probe ahead of the first filter that is almost impossible to remove completely. A single stage filter of EPA recommended material in an in-stack sampler can be 99% or more efficient by weight without any back-up filter. The EPA system took more than twice as long per test as the less cumbersome in-stack system. Collection in the impinger portion of the EPA train showed an apparently created material that can be volatilized off at higher temperatures. Flue gas moisture content can be established just as accurately by combustion calculations from fuel and gas analyses as by trapping and weighing the moisture in the sampled gas. Isokinetic sampling rates for the EPA system will usually be higher because its S-type pitot tube will indicate a higher velocity head than that obtained by a Fechheimer probe. Laboratory and field test results are presented.

[illegible]

Beltzer, Morton

MEASUREMENT OF VEHICLE PARTICULATE EMISSIONS. Preprint, National Inst. of Health, Research Triangle Park, N. C., National Inst. of Environmental Health Sciences and Environmental Protection Agency, Research Triangle Park, N. C., Office of Research and Development, 8p., 1974. 5 refs. (Presented at the Health Consequences of Environmental Controls: Impact of Mobile Emissions Controls, Durham, N. C., April 16-19, 1974.)

An automobile exhaust particulate sampling system is described which is capable of frequent and convenient operation, is compatible with constant volume sampling, and collects particulate matter at constant temperature during the 1972 or 1975 Federal Test Procedure. Compatibility is obtained because the particulate sampler requires only a small portion of the diluted exhaust and the major portion of the sample is thus available to the constant volume sampling system for the measurement of gaseous emissions. The system consists of a diluent air preparation system, a flow development tunnel, and exhaust injection system, an isokinetic sampling probe, and a particulate measurement device.

[illegible]

Funkhouser, John T., Edward T. Peters, Philip L. Levins, Arnold Doyle, Paul Oliver, and John McCoy

MANUAL METHODS FOR SAMPLING AND ANALYSIS OF PARTICULATE EMISSIONS FROM MUNICIPAL INCINERATORS (FINAL REPORT). Little (Arthur D.), Inc., Cambridge, Mass., Environmental Protection Agency Contract 68-02-1137, Program Element 1AA010, Rept. EPA-650/2-73-023, 287p., Sept. 1973. 83 refs. NTIS: PB 230 476/AS

Manual methods for the sampling and analysis of particulate emissions from municipal incinerators were evaluated. Particulates consist of chloride, sulfate, nitrate, and cations such as zinc, lead, tin, iron, potassium, sodium, titanium, and aluminum. An information base was prepared which describes incineration processes and sampling methodology and procedures. The technology necessary to meet the program objectives was defined. Field tests were conducted using the EPA sampling train to evaluate the plan. The train caught more than 80% of the particulate catch in the probe/cyclone and filter. Very little of the material caught in the impingers was related to what is considered particulate. The impinger catch is essentially mineral acid. It is not clear whether the oxidation of sulfur dioxide in the sampling train is a potential source of error in the impinger catch.

[illegible]

Goulding, F. S. and J. M. Jaklevic

DEVELOPMENT OF AIR PARTICULATE MONITORING SYSTEMS (FINAL REPORT). California Univ., Berkeley, Lawrence Berkeley Lab., Environmental Protection Agency Interagency Agreement EPA-IAG-D4-0377, ROAP 26AAI, Program Element 1A1010, Rept. EPA-650/4-74-030, 67p., July 1974. 8 refs.

Results of the first year of a 3-year research program in the fabrication of a high-speed aerosol system are described. Twelve automated dichotomous sampling stations which collect particles in the 0 to 2 to 20 micron diameter ranges will be built. A prototype virtual impactor for aerodynamically separating particles into two size ranges is described, and design improvements for minimizing losses are discussed. Design parameters were determined for a high-speed energy dispersive X-ray fluorescence spectrometer capable of analyzing elements with atomic numbers above 13 during the first year of the research program. A prototype beta gauge for total mass determination was tested, and a detection limit of 10 micrograms/sq cm was measured. For the purpose of sample identification, a system is described by which the X-ray spectrometer and beta gauge will be able to identify a digital code on each filter. (Author abstract modified)

70714

Jaenicke, R. and I. H. Blifford

THE INFLUENCE OF AEROSOL CHARACTERISTICS ON THE CALIBRATION OF IMPACTORS. J. Aerosol Sci., 5(5):457-464, 1974. 11 refs.

Experiments investigating the influence of aerosol characteristics on the calibration of impactor collection efficiency were performed, with the results being compared to earlier experimental calibrations and recent theoretical calculations. Rectangular jet impactors were calibrated with a procedure which avoided the production of multiple polystyrene particles. The original hydrosol of the polystyrene particles was reactivated ultrasonically to break up all multiple particle agglomerates. Large dilutions with distilled water were used to minimize the formation of agglomerates during spraying of the hydrosol. Special variable-slit impactors were constructed for calibration purposes, and an optical particle counter was used to monitor the performance of the aerosol generator. The calibration curve obtained differed greatly from earlier calibrations, though it was in close agreement with recent theoretical calculations. Systematic changes in calibration curves over the years and their departure from the present results suggest that earlier calibrations may have been affected by the character of the calibration aerosols.

72100

Neustadter, H. E., S. M. Sidik, R. B. King, J. S. Fordyce, and J. C. Burr

THE USE OF WHATMAN-41 FILTERS FOR HIGH VOLUME AIR SAMPLING. Atmos. Environ., 9(1):101-109, Jan. 1975. 23 refs.

Paired measurements of suspended particulates with glass fiber filters and Whatman-41 filters were taken at 16 sites over a high-volume air sampling network during a 13-month period to determine the feasibility of replacing glass fiber filters with the Whatman filters. The suspended particulate samples from the glass fiber filters averaged slightly, but not significantly, higher than those from the Whatman-41 filters. Extra handling procedures were required to avoid errors due to the hygroscopic nature of the Whatman-41 filters which demonstrated their practicability for air quality monitoring and elemental analysis in urban environments similar to the test site in Cleveland, Ohio. (Author abstract modified)

72974

Lao, R. C., R. S. Thomas, L. Dubois, and J. L. Monkman

IMPROVED METHODS OF SAMPLING AND ANALYSIS OF AIRBORNE HAZARDOUS PARTICULATE POLLUTANTS. Preprint, Environment Canada, Ottawa, Air Pollution Control Directorate, 7p., 1974. (Presented at the Health Effects of Environmental Pollution, International Symposium Paris, France, June 24-28, 1974.)

Problems involved in the collection of airborne particulates composed of compounds with high vapor pressures are discussed. Although the analysis of volatile components of arsenic, selenium, and mercury as well as the analysis of polynuclear aromatics is continually being upgraded with such techniques as gas chromatography, mass spectrometry, and spectrophotometry, few changes are evident in the collection of such compounds. Particulate pollutants having high vapor pressures appear capable of either passing through conventional filter media without being trapped or evaporating from the collected particulates with the continuing passage of the air stream. Calculated equilibrium vapor concentrations for various polynuclear and arsenic compounds indicate that vapor losses during sampling may be appreciable.

73060

Knollenberg, Robert G.

ACTIVE SCATTERING AEROSOL SPECTROMETRY. Nat. Bur. Stand. U. S. Spec. Publ., no. 412:57-64, Oct. 1974. (Presented at the National Bureau of Standards Seminar on Aerosol Measurements, Gaithersburg, Md., May 7, 1974.)

Aerosol sizing methods are reviewed, with particular emphasis on active scattering aerosol spectrometry. Active scattering spectrometers use the active open cavity of a laser as the source of particle illumination, with the interferometric aspects of the system producing both forward and backward scattered radiation at all collecting angles. This, coupled with the use of an extremely intense source and the fact that the collecting optics solid angle can be considerably greater than 1 steradian, results in a highly sensitive system capable of sizing particles with diameters of several hundred Angstroms using solid state silicon detectors. Size measurements are obtained from the pulse height, and the sensitivity in terms of converted photocurrent is 1 microampere of signal per micron squared of scattering cross section. A field depth of 1 or 2 mm can be obtained without appreciable change in the scatter function. (Author abstract modified)

73061

Carter, William Jackson, III

QUANTITATIVE X-RAY PHOTOELECTRON SPECTROSCOPY AND APPLICATIONS TO AIR POLLUTION. Tennessee Univ., Knoxville, Physics Dir., Thesis (Ph.D.), Sept. 1974, 137p. 71 refs. NTIS: ORNL-TM-4669

The technique of electron spectroscopy for chemical analysis (ESCA) was evaluated for analyzing air pollution samples of particulate matter. Three particulate air pollution samples and the filter paper on which they were collected were studied using aluminum potassium alpha excitation. The elements comprising the major composition of each sample were identified from the binding energy position of the peaks arising from the photoionization of core electrons. Different chemical states or environments for certain elements were also observed. The composition for one of the particulate matter samples was examined in detail in order to obtain qualitative and quantitative identification of the elements present. X-ray photoelectron spectroscopy (XPS) is potentially applicable for routine analysis of these type samples. The sample was also examined by Auger electron spectroscopy (AES) and was in agreement with the XPS data for lead and sulfur. (Author abstract modified)

73063

Shofner, Frederick M., Gunter O. Schrecker, Thomas R. Carlson, and Ronald O. Webb

MEASUREMENT AND INTERPRETATION OF DRIFT-PARTICLE CHARACTERISTICS. State of Maryland, Power Plant Siting Program and Atomic Energy Commission, Washington, D. C., Div. of Biomedical and Environmental Research, Cooling Tower Environm. Symp., College Park, Md., 1974, CONF-740302, p. 427-454, 1975. 6 refs. (March 4-6.)

The measurement and interpretation of drift-particle characteristics associated with cooling towers are discussed. Representative accuracies associated with data generated by laser light scattering, sensitive paper, and isokinetic sampling techniques are around + or - 15% for particle density distributions resulting from typical evaporative cooling device installations. The accuracy of particle density distribution data interpretation strongly depends on maintenance of calibration and the acquisition of a solid statistical data base. Particle density distribution is thus most basic and important drift parameter for predicting transport. In contrast, mass measurements which necessarily report an apparent drift water mass are of no utility in evaluating the environmental effects of a cooling system. (Author conclusions modified)

73130

Marple, V. A.

DEVELOPMENT, CALIBRATION AND APPLICATION OF SIZE DISTRIBUTION INSTRUMENTS AT THE UN[illegible] OF MINNESOTA. Nat. Bur. Stand. U. S. Spec. [illegible] 412:149-176, Oct. 1974. 15 refs. (Presented at the Nation[illegible] reau of Standards Seminar on Aerosol Measurements, Gaithersburg, Md., May 7, 1974.)

Progress in the development, calibration, and application of size distribution instruments at the University of Minnesota is reviewed. Topics covered include: the development and operation of an electrical aerosol analyzer for in-situ measurements over the 0.003-1.0 micron diameter range; the use of a vibrating orifice monodisperse aerosol generator for calibrating aerosol measuring and sampling equipment; the generation of submicron (below 0.1 micron) aerosols with pneumatic atomization and electrostatic classification; the calibration of condensation nuclei counters; the use of submicron aerosol generators for the calibration of the electrical aerosol analyzer; calibration methods for optical particle counters using ideal and nonideal aerosols; the development of various aerosol size distribution measurement systems; and conclusions drawn from field studies of atmospheric aerosol particle size distributions. Fine particles constitute about 1/3 of the total atmospheric aerosol mass on the average, with moderately polluted urban areas showing fine particle size concentrations of around 50 micrograms/cu m and coarse particle concentrations of around 120 micrograms/cu m.

73084

Reisman, E., W. D. Gerber, and N. D. Potter

IN-STACK TRANSMISSOMETER MEASUREMENT OF PARTICULATE OPACITY AND MASS CONCENTRATION

(FINAL REPORT). Philco-Ford Corp., Newport Beach, Calif., Aeronutronic Div., Environmental Protection Agency Contract 68-02-1229, Program Element 1AA010, ROAP 26AAM, Rept. EPA-650/2-74-120, 116p., Nov. 1974. 13 refs.

Field test evaluations of a transmissometer for in-stack measurements of particulate opacity and mass concentration were conducted at six industrial sites. The performance of the transmissometer as a continuous monitor was evaluated at each site for a period of 30 days. Plume opacities were also measured by one of several objective methods such as telephotometry, and mass concentrations were measured directly with an Environmental Protection Agency particulate sampling train (Method 5) for comparison purposes. The transmissometer performed accurately and reliably, detecting density changes of 0.001. The presence of water droplets when the stack gas was below the dew point temperature was recorded by the instrument as particulates, and the presence of sulfur trioxide in vapor form was not detected since, like all optical devices, the transmissometer only measures the characteristics of the particulates it encounters. Zero drifts were generally very small for the instrument. At one site a high vibration level created the need for continual check of the alignment.

75110

Ranade, Madhav B.

SAMPLING INTERFACE FOR QUANTITATIVE TRANSPORT OF AEROSOLS (FINAL REPORT). IIT Research Inst., Chicago, Ill., Environmental Protection Agency Contract 68-02-0579, Proj. 26AAM, Program Element 1AA010, Rept. EPA-650/2-74-016, 141p., Dec. 1973. 6 refs. NTIS: PB 230953/AS

A sampling probe for the quantitative transport of aerosols through a conduit from a source to a sensor is described. The probe consists of a porous metal tube encased in a manifold through which transpiration air is passed inward to provide a moving clean air sheath that minimizes particle deposition on the walls. The probe, which is 178 cm by 1.27 cm in size, requires only 14.2 l/min of transpiration air to virtually eliminate the deposition of particles in the 0.05 to 15 micron size range. Particles as large as 70 micron require as much as 283 l/min to prevent deposition losses at low sample flow rates. The porous probe is also effective in the preservation of size distribution. Optimization of the sample and transpiration flow ratio is necessary for a given size range to obtain the most effective use of the porous probe. (Author abstract modified)

75111

Roberts, D. W., W. M. Farmer, and A. E. Lennert

INTERFEROMETRIC INSTRUMENTATION FOR PARTICLE SIZE ANALYSIS (FINAL REPORT). Arnold Research Organization, Inc., Arnold Air Force Station, Tenn., Environmental Protection Agency Interagency Agreement EPA-IAG-0177(D), Program Element 1AA010, ROAP 26AAM, Rept. EPA-650/2-74-034, 95p., June 1974. 17 refs. NTIS: PB 236066/AS

Results from experiments conducted to determine the characteristics and potential capabilities of particle size analysis with laser interferometer techniques are reported. The fringe visibility technique appears capable of being incorporated into a viable instrument for the real time analysis of particle sizes simultaneously with velocity measurements. Particle sizes from the millimeter range to 1 micron can be determined; however, the threshold of detection is not established. For self-aligning optics, 0.5 wavelengths of the illuminating beam appears to be the limit, e.g., in the case of the helium-cadmium laser, operating at 4416 A, approximately 0.22 micron. The threshold is further lowered to 0.17 micron by operating the laser at 3250 A. One-dimensional particle sizing experiments leave much to be desired, and two-dimensional particle sizing is a minimum condition for realizing reliable measurements.

75113

Ringwall, Carl G.

COMPACT SAMPLING SYSTEM FOR COLLECTION OF PARTICULATES FROM STATIONARY SOURCES (FINAL REPORT). General Electric Co., Schenectady, N.Y., Environmental Protection Agency Contract 68-02-0546, Program Element 1AA010, Rept. EPA-650/2-74-029, 109p., April 1974. 8 refs. NTIS: PB 234700/AS

A compact sampling system for the collection of particulates from stationary sources is described, with particular emphasis on the gas velocity sensor and a fluidic control amplifier. The sensor concept is based on the static pressure differential between the free air stream and the nozzle inlet. The fluidic control amplifier which interfaces directly with the sensor provides the control to automatically maintain isokinetic conditions. Field tests at both oil- and coal-fired power plants indicate that the sensor and controller can function with no degradation in performance under the adverse environment of representative power plant stacks. Temperatures of up to 300 C and solid particulate concentrations of 3.50 g/cu m can be tolerated by the sampling system. (Author abstract modified)

75147

Conner, William D.

MEASUREMENT OF THE OPACITY AND MASS CONCENTRATION OF PARTICULATE EMISSIONS BY TRANSMISSOMETRY. Environmental Protection Agency, Research Triangle Park, N.C., Chemistry and Physics Lab., Program Element 1AA010, ROAP 26AAM, Rept. EPA-650/2-74-128, 37p., Nov. 1974. 23 refs. NTIS: PB 240251/AS

The transmissometric measurement of opacity and mass concentration of stack particulate emissions is reviewed. Transmissometers used to measure the opacity of particulates possess two essential design features: the spectral response of the instrument is limited to visible light (sensitive to green light mostly) and the light collimating optics of the instrument exclude light scattered by the particulates from measurement. Although only a limited opacity-mass concentration relationship can be expected between sources of different sizes and particulate characteristics, a good opacity-mass concentration relationship can be obtained for sources with stable particulate characteristics. Such a relationship is usually developed by empirical calibration of a transmissometer on the source with an accepted manual gravimetric sampling method. Two relatively simple methods exist for remote instrumental measurement of opacity. They are through-the-plume photometry of the sun and telephotometry of contrasting targets. A more general lidar method for remote opacity measurements is currently being developed.

75187

Brooks, E. F., E. C. Beder, C. A. Flegal, D. J. Luciani, and R. Williams

CONTINUOUS MEASUREMENT OF TOTAL GAS FLOWRATE FROM STATIONARY SOURCES (FINAL REPORT). TRW Systems Group, Redondo Beach, Calif., Environmental Protection Agency Contract 68-02-0636, Program Element 1AB013, ROAP 21ACX-AS, Rept. EPA-650/2-75-020, TRW 23000-6010-RU-00, 163p., Feb. 1975. 7 refs. NTIS: PB 241 896/AS

Laboratory and field evaluations of hardware and techniques for the continuous measurement of the total gas flow rate from stationary sources were conducted, with particular emphasis being placed on large or complex ducts where total flow metering devices such as plate orifices are not practical. The total volumetric flow rate in either circular or rectangular ducts was measured with accuracies consistently better than 10% when from one to eight flow sensors were properly positioned; standard traversal techniques would require from 20 to 48 traverse points. Rectangular duct mapping techniques displayed optimum accuracy immediately downstream of an elbow. Several off-the-shelf velocity sensors were acceptable for use in the specified stack-type environment. (Author abstract modified)

75048

Nichols, Grady B.

TECHNIQUES FOR MEASURING FLY ASH RESISTIVITY (FINAL REPORT). Southern Research Inst., Birmingham, Ala., Environmental Protection Agency Contract 68-02-1303, Program Element 1AB012, Rept. EPA-650/2-74-079, 45p., Aug. 1974. 9 refs. NTIS: PB 240168/AS

The methods used for the measurement of the electrical resistivity of particulate matter suspended in an effluent gas stream are discussed. The behavior of an electrostatic precipitator is related to the value of the resistivity of the suspended particulate. Some of the mechanisms of electrical conduction in fly ash from coal combustion are described as they influence resistivity. A discussion is also included of in situ versus laboratory techniques for measuring resistivity and the interpretation of data measured by these methods. The point to plane probe provides data that are more clearly consistent with observed behavior of operating electrostatic precipitators than the other alternative devices. This factor, together with the similarities between the operation of a precipitator and the instrument are the basis for the selection of the point to plane device as the preferred measurement instrument. (Author abstract modified)

75061

Smith, W. B., K. M. Cushing, G. E. Lacey, and J. D. McCain

PARTICULATE SIZING TECHNIQUES FOR CONTROL DEVICE EVALUATION. Southern Research Inst., Birmingham, Ala., Environmental Protection Agency Contract 68-02-0273, Program Element 1AB012, ROAP 21ADM-011, Rept. EPA-650/2-74-102-a, SORI-EAS-75-369, 132p., Aug. 1975. 13 refs. NTIS: PB 245184/AS

Laboratory and field evaluations of inertial sizing techniques (cyclones and cascade impactors) were performed in an effort to find a suitable method for the evaluation of pollution control devices. Laboratory tests with hard, dry aerosols indicated that approximately 10 m/sec is the practical upper limit for impactor jet velocities if reentrainment is to be avoided. Glass fiber substrate weight gains which were mostly due to sulfate uptake on the substrates constituted a severe problem. Preconditioning of normal Gelman type A substrates for several hours in flue gas reduced the weight gains considerably. Teflon, Whatman GF/A and GF/D, and Reeve Angel 934 AH were glass fiber materials which showed little weight gain. Electrostatic effects posed a substantial interference with bare collection plates, although the effect with glass fiber substrates was minimal. Design and calibration data were also obtained for two series of cyclone size devices: one designed to operate at a flowrate of 140 l/min and the other at 28 l/min. Each provided three size fractionation points in the 0.5-10 micron size interval. The cyclone systems permitted the collection of larger quantities of size fractionated particulates and were somewhat easier to use than were the impactors. (Author abstract modified)

76488

Mitchell, William J. and M. Rodney Midgett

METHOD FOR OBTAINING REPLICATE PARTICULATE SAMPLES FROM STATIONARY SOURCES (FINAL REPORT). Environmental Protection Agency, Research Triangle Park, N.C., Quality Assurance and Environmental Monitoring Lab., Program Element 1HA327, ROAP 26AAG, Rept. EPA-650/4-75-025, 34p., June 1975. 7 refs. NTIS: PB 245050/AS

Dual sampling arrangements that allowed four independent trains to sample simultaneously at the same point in a stack were used to obtain replicate particulate samples from stationary sources. A total of 16 particulate sampling runs with four identical Environmental protection Agency Method 5 particulate trains revealed that the magnitude of the within-run standard deviation was linearly related to the magnitude of the mean particulate concentration measured for that run. However, no such relationship was found between the within-run standard deviation and either the run sampling time or the total volume of gas sampled. A statistical analysis of the percent moisture in the stack determination was used to estimate the precision of the condensation technique used in the Method 5 train. (Author abstract modified)

77724

Kurtz, Jerome L. and John G. Olin

A NEW FLOW CONTROLLER FOR HIGH VOLUME AIR SAMPLERS. Preprint, Air Pollution Control Assn., Pittsburgh, Pa., 13p., 1975. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-60.6.)

A constant flow controller for high volume particulate samplers is described. The device uses a constant-temperature thermal anemometer which measures the mass flow of the sampled air. A triac motor speed regulator in a feed-back control loop maintains the flow rate constant over the selectable range of 20-60 standard cu ft/min. The flow rate error caused by filter loading, temperature variation, line voltage changes, change of filters and motor brushes, and the installation of a top-loading calibrator is at most 1.1 standard cu ft/min. (Author abstract modified)

77725

Porch, William M. and James E. Lovill

SATELLITE AND SURFACE OBSERVATIONS OF TEXAS DUST STORMS. Preprint, Air Pollution Control Assn., Pittsburgh, Pa., 18p., 1975. 15 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-60.4.)

Fast-response surface measurements and satellite observations of Texas dust storms were made in March and April of 1974. Nephelometer measurements of dust showed a strong correlation with simultaneous wind measurements. The vertical gradient of the nephelometer signals, which is a measure of the aerosol flux, showed a very strong power law relationship to the horizontal wind velocity. Frequency response and spectral density comparisons of the wind and dust data proved to be valuable tools for understanding the physical properties of dust suspension by wind. The analysis of satellite data demonstrated the applicability of spectral separation of dust and cloud phenomena. (Author conclusions modified)

77889

Batigan, Robert M. and Philip R. Morey

AN ENGINEERING ANALYSIS OF THE RESPIRATORY AND TOTAL DUST PROBLEMS ASSOCIATED WITH COTTON TEXTILE PROCESSING OPERATIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 16 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-68.3.)

Results from an experimental comparison of several total and respirable dust concentration sampling techniques under simulated cotton textile processing conditions are presented. The methods evaluated are: the Environmental Protection Agency-type high volume sampler for total dust, the Occupational Safety and Health Administration-type vertical elutriator for total and respirable cotton dust, and the Andersen multistage cascade impactor for the determination of dust size distribution. The total dust monitor of the vertical elutriator must be mounted at the same height as the entrance to the elutriator pump if particle size distributions comparable to the standard high volume sampler are to be obtained. Inconsistent results are obtained with the vertical elutriators at flow rates of 6.8-7.5 l/min; at reduced flows of 1.8-4.3 l/min, reproducibility of the data is excellent, however. The cumulative particle size distributions obtained by the Andersen and high volume samplers are identical within experimental error for airborne emissions from carding strict middling cotton. Very good agreement is also obtained for good middling cotton carding emissions. The Andersen units consistently yield total dust concentrations 40% lower than the corresponding results from the standard high volume sampler. Multistage cascade impactors appear to be of limited utility in cotton dust sampling. (Author abstract modified)

77890

Bernstein, David, Michael T. Kleinman, Theodore J. Kneip, Tai L. Chan, and Morton Lippmann

DEVELOPMENT OF A HIGH-VOLUME SAMPLER FOR THE DETERMINATION OF PARTICLE SIZE DISTRIBUTIONS IN AMBIENT AIR. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1975. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-60.5.)

A size selective particle sampler has been developed for continuous sampling of the urban aerosol over periods ranging from hours to weeks. It uses a parallel array of two-stage samplers. The cyclones used as the first stage collectors have 50% particle retention at 7.5, 3.5, 1.5, and 0.5 micron aerodynamic diameter, respectively. Undersize particles passing through the cyclones are captured on glass fiber filters. Equal intake velocities are assured by flow equalizers on the inlets to the cyclones. Accurate control of the flow through the cyclones is obtained using an integrated circuit pressure transducer in conjunction with a specially designed feedback control circuit. The collection efficiencies of the cyclones were calibrated using monodisperse ferric oxide test aerosols tagged with Tc-99m. Mass balances of the particulates collected on the cyclones and filters are obtained for the five sampling stages. The sampler was operated in New York City for periods of 1 wk at rooftop level (11 stories). The concentrations in micrograms/cu m of the total suspended particulates measured by the particle size sampler are in excellent agreement with a constant flow sampler operating at the same site over the same sampling period. By taking the differences in the measured concentrations in each of the following particle size regions are obtained: less than 0.5 micron; 0.5 to 1.5 micron; 1.5 to 3.5 micron; 3.5 to 7.5 micron; greater than 7.5 micron. A bimodal distribution of the aerosol is observed. The distribution of lead, zinc, and manganese with particle size were determined by analyses of the filter samples and are discussed. (Author abstract modified)

77893

Lilienfeld, Pedro

A NEW AMBIENT PARTICULATE MASS MONITOR USING BETA ATTENUATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-60.2.)

A particulate mass monitor has been developed for the automated measurement of ambient aerosol concentrations, based on beta radiation attenuation of two concurrently collected filter samples, representing the total and the respirable size fractions. The instrument incorporates a high-flow rate sampling inlet, isokinetic secondary collection flow extraction, flow control by an upstream venturi-type critical nozzle, and a double-beta detection rotating head configuration permitting uninterrupted sample collection without time loss associated with beta counting. The instrument also incorporates a microprocessor especially programmed for this application, which performs all signal processing, control, timing, self-testing and computation functions. The ambient particulate monitor has been designed for maximum compatibility with typical telemetry systems used on air pollution monitoring networks with central computer data collection. Unattended operation for almost a full year for 1-hour sampling periods appears feasible. (Author abstract modified)

77941

Pegley, M. J., D. S. Ensor, and L. E. Sparks

THE PROPAGATION OF ERRORS IN PARTICLE SIZE DISTRIBUTION MEASUREMENTS PERFORMED USING CASCADE IMPACTORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 28p., 1975. 10 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.5.)

A fundamental error analysis in particle size distribution measurements performed using cascade impactors was conducted. The effects of flow condition fluctuations and construction tolerances are analyzed using the solutions of differential equations describing the deposition efficiency of a round hole jet impactor. The important sources of random error are the weighing of the particle deposits, the tolerance in drilling the jet holes, and the variation in flow rate through the impactor. The difficulty of generalizing the error analysis and the need to apply to specific situations are stressed. These errors are controlled by using an analytical balance with the best precision available and with good quality control of the impactor construction. Careful size determination is best achieved by calibrating the impactor with a test aerosol. (Author summary modified)

77971

Shofner, Frederick M., Gerhard Kreikebaum, and Harold W. Schmitt

IN SITU CONTINUOUS MEASUREMENT OF PARTICULATE MASS CONCENTRATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1975. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-61.1.)

An instrument capable of making in situ continuous measurements of particulate mass concentration, independent of particle size distribution for the particle size range of 0.05-10 micron diameter, is described. The instrument is based on the principle of laser light scattering and is essentially a backscattering device. The backscattered light is detected in a combination of angles in the backangle lobe. The incident light is a highly collimated beam of monochromatic light whose wavelength is 0.9 micron. The critical electro-optical components are all contained at the end of a probe which may be inserted any distance into essentially any process gas stream. The sampling volume is completely optically defined and encompasses approximately 12 cu cm. This volume is external to the probe and is configured relative to the probe so that the probe does not disturb the sampled gas stream as it passes through the sampling volume. The sensitivity of the instrument of 0.001 grains/actual cu ft of process gas. Results of a series of simultaneous measurements with the device and with a standard isokinetic sampling train downstream of a precipitator serving a coal-fired power plant are presented.

77094

Lebowitz, Malcolm F.

SHORT TERM TESTING FOR FUGITIVE DUST EFFECT. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1975. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-28.4.)

Examples of short-term testing for fugitive dust emissions are provided. Gravitational separation is the basis of test site location, and two or more test locations, well beyond the heavy settling range, are designated as boundary sites. Another location near the source, within the heavy settling range, is the source site. Ambient air quality particulate matter concentrations are measured by the high volume method. The air sample is drawn through a filter situated in a covered housing at about 50 cu ft/min for approximately 24 hr. The data are tabulated in a two dimensional array to ascertain variations due to daily effects and locations. Suspended particulate concentrations are reported for areas around a wood products process, a cement plant, and one new and one existing steel plant. The tabulated data indicate concentrations greater than the national primary standard.

77099

Kalika, Peter W., Paul T. Bartlett, Robert E. Kenson, and John F. Yocom

MEASUREMENT OF FUGITIVE EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.3.)

Methods for measuring fugitive particulate and gaseous emissions from various industrial sources are discussed. The three basic measurement approaches being investigated in laboratory and field tests are: the quasi stack method in which the fugitive emission is temporarily hooded and a temporary duct or stack and fan are installed to permit sampling by means of standard stack sampling methods; the monitoring of roof and other vent openings to determine air and material balances through these openings; and outdoor sampling during prescribed meteorological conditions using sampling grids upwind and downwind of the source. A cost-effectiveness analysis of sampling strategy/industry source combinations indicates that the cost-effectiveness of a given sampling strategy is dependent on the source to be tested. A quasi-stack strategy is more cost effective for a single source such as a gray iron cupola; whereas a roof monitoring program is preferred for a copper smelter converter building, for example. A list of 10 industry/process combinations that are potentially significant fugitive emission sources is provided. (Author abstract modified)

78102

Nader, John S.

CURRENT TECHNOLOGY FOR CONTINUOUS MONITORING OF PARTICULATE EMISSIONS. Air Pollution Control Assoc., 25(8):814-821, Aug. 1975. 40 refs.

Particulate matter is characterized by its physical and chemical properties. Federal and state emission standards identify two important physical properties, opacity (visible emissions) and particulate mass concentration. In addition, particle size and particle composition are characteristics that play a significant role in the assessment of health effects, visibility, and control strategy. Systems to monitor these particle characteristics are in various stages of development. Opacity monitors have the longest history of commercial availability and of applicability to various source emissions. Particulate mass monitors have a short history as commercially available systems and are under evaluation in various source applications. Particle monitors are mainly in the advanced prototype development stage. Real time size monitoring systems will eventually be wedded to real time particle composition analyzers to give a monitoring system for particle size distributions of chemical constituents.

78110

Owens, Joshua R. and Robert M. Bethea

SCREENING TECHNIQUE FOR HAZARDOUS METALLIC COMPOUNDS IN PARTICULATE STACK EFFLUENTS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1975. 16 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.1.)

A rapid screening technique for hazardous metallic compounds in particulate stack effluents was developed for the oxides of antimony, iron, chromium, nickel, vanadium, tin, and silver. The qualitative procedures, originally based on standard geochemical and quantitative analysis methods are modified to conform to the anticipated lower detection limits required for the screening particulate stack samples obtained as a result of emission or compliance testing. Solubilization is achieved by digestion in 0.5 N nitric acid followed by selective solubilization of copper oxide, ferrous oxide, ferric oxide, and vanadium pentoxide in hot 3 N nitric acid and the fused solution of beryllium oxide and antimony oxide in hot concentrated sulfuric acid. Subsequent cation separation is obtained by complex forming extractions in suitable solvents at an appropriate pH. (Author abstract modified)

78117

Dzubay, T. G., L. E. Hines, and R. K. Stevens

PARTICLE BOUNCE ERRORS IN CASCADE IMPACTORS. Preprint, Environmental Protection Agency, Research Triangle Park, N. C., 24p., 1975. 10 refs.

Field measurements of atmospheric aerosols using cascade impactors indicated that the nature of the impaction surface exerts a significant effect on the apparent size distribution. The tests were performed with two identical cascade impactors operating simultaneously. Dry impaction surfaces (aluminum foil, glass [illegible] filter material, and wax-coated paper) were used in the first impactor, while grease-coated foils were used in the second as a reference. A comparison of the measured size distributions indicated that the use of dry impaction surfaces leads to a distorted measurement of the size distribution.

The distortion is attributed to particles bouncing off of the dry impaction surfaces and being collected on subsequent stages or on the backup filter. (Author abstract modified)

79891

Brenchley, David L., C. David Turley, and Raymond F. Yarmac

USE OF THE EPA PARTICULATE TRAIN FOR COMPLIANCE TESTING. In: Air Pollution Control and Industrial Energy Production. Kenneth E. Noll, Wayne T. Davis, and Joseph R. Duncan (eds.), Ann Arbor, Mich., Ann Arbor Science, 1975 (?), Chapt. 6, p. 75-85. 7 refs.

A specific sampling procedure has been developed, known as Environmental Protection Agency Method 5, for conducting source compliance tests. The EPA Method 5 in essence refers only to dry particulate at 250 F. The sampling train is described, including the nozzle and probe, the pitot tube, the filter, the cyclone, the impingers, the sampling box, the umbilical cord, and the meter box. The performance, and hence calibration of the orifice meter is of primary importance and is critical to the maintenance of isokinetic conditions. The other critical pieces of equipment are the pitot tube and dry gas meter. Routine maintenance and calibration procedures are outlined. The test procedures are also included. Care must be taken in shutting down the sampling equipment at the end of the sampling period.

81470

Anderson, Paul L.

DEVELOPMENT OF A CENTRIFUGE FOR SOURCE SAMPLING TO DETERMINE PARTICLE SIZE DISTRIBUTION. Environ. Sci. Technol., 10(2):145-150, Feb. 1976. 8 refs.

A small centrifuge source-aerosol sampler with a spectral calibration range of from 0.16-3 micron is described. The sampler includes multi-orifice cascade impactor plates ahead of the centrifuge to process coarse particulates. The centrifuge is thermally protected and small enough to be used for some in-stack sampling applications. The application of the sampler to the collection of aerosols before and after a fluid bed reactor baghouse on the experimental aluminum reduction cell is described. The fluid alumina bed appears to be an efficient collector of fine fume particles as well as hydrogen fluoride. Coarse fines (1-10 micron) predominately penetrate the baghouse as opposed to fines less than 1 micron in size. (Author abstract modified)

81490

Maddalone, Ray F., Ronnie L. Thomas, and Philip W. West

MEASUREMENT OF SULFURIC ACID AEROSOL AND TOTAL SULFATE CONTENT OF AMBIENT AIR. Environ. Sci. Technol., 10(2):162-168, Feb. 1976. 20 refs.

A procedure for the measurement of sulfuric acid aerosol and total sulfate content of ambient air is described. The procedure involves the formation of perimidylammonium sulfate and subsequent thermal decomposition to form quantitatively sulfur dioxide. The SO_2 may be determined colorimetrically by the West-Gaeke procedure or by means of flame photometry. Airborne particulate samples are analyzed by isolating the sulfuric acid by microdiffusion, and total sulfate is determined by aqueous extraction of the particulate samples. A working range of 1-50 micrograms of sulfate can be handled conveniently, and the determination (excluding microdiffusion) requires only a few minutes. (Author abstract modified)

82794

Gravatt, C. C., Jr.

REAL TIME MEASUREMENT OF THE SIZE DISTRIBUTION OF PARTICULATE MATTER IN AIR BY A LIGHT SCATTERING METHOD. Preprint, National Bureau of Standards, Washington, D. C., Inst. for Materials Research, 8p., 1972. 8 refs.

A light scattering method for the real time measurement of the size distribution of airborne particulate matter is described which produces results that are independent of the index of refraction of the particles. The method involves the simultaneous measurement of the intensity of light scattered by a single particle at two small scattering angles as the particle flows through a scattering chamber. The ratio of the two intensities is proportional to the size of the particle but is independent of its index of refraction. The size of each particle can be determined in about 20 microseconds. The lower measurable particle size is about 0.3 micron with a helium-neon laser source and 0.05 micron with an argon laser source. Changes in particle size distribution can be determined within a few seconds by employing a multichannel analyzer as the data storage and readout device. (Author abstract modified)

84722

Roberts, P. T. and S. K. Friedlander

ANALYSIS OF SULFUR IN DEPOSITED AEROSOL PARTICLES BY VAPORIZATION AND FLAME PHOTOMETRIC DETECTION. Atmos. Environ., vol. 9:403-408, 1975. 15 refs.

An aerosol vaporization method that measures sulfur at the nanogram level directly from the collection substrate is described. Detection is provided by a flame photometric sulfur analyzer. Calibration shows the method to have a coefficient of variance of 7.5% and a lower limit of detection of 1 ng sulfur, independent of sulfur species. The method will respond to sulfur compounds which evaporate or decompose below about 1200 C. The method has been used to measure aerosol sulfur concentrations (both total filter and with respect to particle size) in the Los Angeles atmosphere and in smog experiments. (Author abstract)

84727

Liu, Benjamin Y. H. and K. W. Lee

EFFICIENCY OF MEMBRANE AND NUCLEPORE FILTERS FOR SUBMICROMETER AEROSOLS. Environ. Sci. Technol., 10(4):345-350, April 1976. 8 refs.

The efficiency of several commonly used membrane and Nuclepore filters has been measured using monodisperse aerosols and a new electrical aerosol detector. Particles in the 0.03- and 1 micron diameter range were used and the filter pressure drop was varied between 1 and 50 cm Hg. The filters tested include Teflon membrane filters of 0.5-, 1.0-, 5.0-, and 10.0-micron diameter pores and Nuclepore filters of 0.5-, 1.0-, 3.0-, 5.0-, and 8.0-micron pores. The minimum filter efficiency ranged from a low of 83% for the 10-micron Teflon membrane filter to a high of greater than 99.99% for the 0.5- and 1.0-micron Teflon filters. For the Nuclepore filters, the minimum filter efficiency ranged from a low of zero for the 8-micron filter to a high of 90% for the 0.5-micron filter. In general, the membrane filter was considerably more efficient than a Nuclepore filter of the same or a comparable pore size. The results suggest that the classical filtration mechanisms of interception, impaction, and diffusion are operative in these filters. (Author abstract)

84729

Kukreja, Ved P. and John L. Bove

DETERMINATION OF FREE CARBON COLLECTED ON HIGH-VOLUME GLASS FIBER FILTER. Environ. Sci. Technol., 10(2):187-189, Feb. 1976. 5 refs.

A convenient and precise method for determining free carbon in a high-volume glass fiber filter is described. A low analytical blank was found, allowing for the determination of small quantities of free carbon. The analytical technique is based on the initial decomposition of the glass fiber mat with hydrofluoric acid, followed by the action of ammonium hydroxide, nitric acid, and hydrochloric acid to dissolve inorganics and digest organics. The amount of free carbon is then determined by the difference in weight recorded when the remaining residue is heated first at 150 C and then at 700 C. The analysis blank for free carbon was low and uniform when Mine Safety and Appliance glass fibers were used. An average blank of 1.1 mg was found when 5 unsoiled filters were examined. Almost no deviation was found when the 5 results were compared.

84730

Natusch, D. F. S. and J. R. Wallace

DETERMINATION OF AIRBORNE PARTICLE SIZE DISTRIBUTIONS: CALCULATION OF CROSS-SENSITIVITY AND DISCRETENESS EFFECTS IN CASCADE IMPACTION. Atmos. Environ., vol. 10:315-324, 1976. 21 refs.

A theory was developed which permits numerical evaluation of errors associated with the determination of aerosol size distributions using cascade impactors. Account is taken of errors due to the overlap of a given particle size between adjacent impaction stages and to the discrete nature of cascade impaction. The theory is applied to both log-normal and polynomial functional approximations to an aerosol size distribution. Numerical determination of errors considered shows that the mass of large and small particles present in the wings of a log-normal aerosol distribution is over-estimated manyfold by most cascade impactors but that the mass of particles having aerodynamic diameters close to the aerosol mass median diameter is generally subject to quite small (less than 20%) negative errors. Even under extremely unfavorable conditions the mass median diameter of an aerosol can be determined to well within 25% of the true value. (Author abstract)

84733

Whitby, Kenneth T.

ELECTRICAL MEASUREMENT OF AEROSOLS. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 581-624. 56 refs. (May.) (Available to EPA-600/2-75-059, Oct. 1975.)

The basic principles of electrical size distribution and concentration measurement methods are reviewed. Electrical aerosol measuring instruments are discussed under three headings: charging, classification and detection. Recent work by Liu and his students shows that the particle charging rate, based on the Boltzmann Law, can best describe bipolar and unipolar diffusion charging of aerosol particles, over the size range and charging conditions of most interest in electrical aerosol measurement. Working equations for calculating diffusion charge are presented. Several charged aerosol classifiers or mobility analyzers are described, including the latest differential mobility analyzers developed at the University of Minnesota. Particle charge versus size curves for bipolar, diffusion and field charging are integrated with some of the latest aerosol size distribution models, in order to calculate the response characteristics of the different kinds of electrical instruments. Three late model electrical aerosol instruments developed at the University of Minnesota are described. These are the Electrical Aerosol Analyzer, the Differential Mobility Analyzer, and an Electrical Aerosol Concentration Meter. (Author abstract)

84734

Lundgren, Dale A., Lawrence D. Carter, and Peter S. Daley

AEROSOL MASS MEASUREMENT USING PIEZOELECTRIC CRYSTAL SENSORS. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 485-509. 31 refs. (May.) (Available to EPA-600/2-75-059, Oct. 1975.)

Studies and papers on the use and performance of piezoelectric crystal sensors for aerosol mass concentration measurement are reviewed. The capabilities and limitations of the piezoelectricity technique, and recent developments and improvements made in commercially available instruments, are discussed. Piezoelectric crystals, when mechanically stressed, develop electrical charges on certain crystal surfaces. Quartz, as a piezoelectric material, vibrates at a very precise natural frequency, which can easily be determined to one part in ten million when the crystal is placed in an appropriate electronic oscillating circuit. When foreign material, such as particulate matter, is deposited onto the crystal active area, the vibrational frequency characteristics of the crystal change in a predictable and measurable manner. This phenomenon led to the development of two commercial instruments which were described in the literature of 1970. These two devices, one based upon particle deposition by impaction and one by electrostatic precipitation, were revolutionary because of their extreme sensitivity and rapid, near real time, response characteristics. (Author abstract)

84736

Marple, Virgil A. and Klaus Willeke

INERTIAL IMPACTORS: THEORY, DESIGN AND USE. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 411-446. 41 refs. (May.) (Available to EPA-600/2-75-059, Oct. 1975.)

Inertial impactors are devices used to classify particles with respect to their aerodynamic size. The theoretical analyzing techniques currently available are sufficiently accurate to predict the impaction characteristics of impactors, provided with the impactor design conforms reasonably well with the boundary condition used in the theoretical analysis. Using results of a theoretical study employing these techniques, design criteria are given for such parameters as jet-to-plate distance, jet Reynolds number, and jet throat length to obtain sharp cut-off characteristics for both round and rectangular impactors. Precautions which must be taken in the use of impactors are discussed, and limitations of impactors due to interstage losses and particle bounce from various surfaces are presented. Various designs of impactor jets and impaction surfaces are examined with special attention given to the use of multiple jet impactors for the purpose of controlling the jet Reynolds number. Also, the principle operating characteristics of commercial cascade impactors are presented. (Author abstract)

84737

John, Walter

CONTACT ELECTRIFICATION APPLIED TO PARTICULATE MATTER MONITORING. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 649-667. 18 refs. (May.) (Available from EPA-600/2-75-059, Oct. 1975.)

The theory of the charging of aerosol particles by contact electrification is reviewed, as well as the development over the past decade of monitors based on this phenomenon. Such monitors offer the advantage of continuous measurements over a wide range of concentrations. Moreover, the total electrical charge collected has been found to correlate well with the total mass determined gravimetrically. The lack of widespread use of these detectors may be due to contradictory reports on their performance as well as uncertainty arising from the presently incomplete understanding of the operating principle. The major factors which influence the instrumental response are discussed, including the recent finding that the sensitivity is strongly dependent on the electrical resistivity of the material sampled. It is also found that the condition of the probe's surface has an important effect on the sensitivity. At present, theoretical understanding of the contact charging is semiquantitative for particles of metals but only rudimentary in the case of insulators. (Author abstract)

04718

Harris, D. B. and W. B. Kuykendal

PROBLEMS IN STACK SAMPLING AND MEASUREMENT. Fine Part. Symp. Proc., Minneapolis, Minn., 1976, p. [illegible] 11 refs. (May.) (Available as EPA 600/2-76-059, Oct. 1976.)

Though many techniques for monitoring particulates have been studied in great detail under laboratory conditions, the application to field situations of these techniques has often been difficult. Attempts to use cascade impactors for manual fractional efficiency and optical and beta gauging for instrumental particle sizing are described. Though each technique seemed to be ideally suited to particle measurement, the many different problems presented by industrial gas streams and the solutions used to overcome them are described. Particle bounce and reentrainment is the first problem discussed, followed by substrate material selection due to reaction with gaseous components. Instrumental problems have centered on getting sensors to perform in the hostile stack environment and on making reasonable compromises necessary to apply these techniques to real stack environments. (Author abstract)

04719

Altpeter, Lawrence L., Jr., J. P. Pilney, L. W. Rust, A. J. Senechal, and D. L. [illegible]

RECENT DEVELOPMENTS REGARDING THE USE OF A FLAME IONIZATION DETECTOR AS AN AEROSOL MONITOR. Fine Part. Symp. Proc., Minneapolis, Minn., 1976, p. 625-647. 10 refs. (May.) (Available as EPA 600/2-76-059, Oct. 1976.)

High speed waveform studies were performed with the output signals of individual aerosol particles as they were consumed in the flame of a flame ionization detector. These output signals were shown to consist of modulated current pulses with mean amplitudes which varied with particle size from 10 to the minus 9th power to 10 to the minus 6th power ampere and with durations from a fraction of a millisecond to several milliseconds. Aerosol measurements were performed with the FID centered in an aerosol test chamber. Sampling conditions of size, number concentration and composition were carefully controlled. Repeatability of the flame ionization detector was estimated to be 5 to 15 percent. Response of the detector was shown to be linear throughout the tested size range of 0.1 to 10 micron. Size limit of detection was 0.15 to 0.2 micron with evidence of ways to improve this limit significantly. Sensitivity varied with particle size as the 1/2 power. There was evidence of limited selectivity when the detector was used with parallel plate electrode geometry. Considerations of the structured current pulses observed with the conventional FID led to design and testing of a novel FID. All features of the novel FID were identical to the conventional model with the exception of the collection electrode which was segmented into a vertical array of horizontal strips. Each strip was a separate and individually addressable electrode. The detector was referred to as a segmented-plate FID, or SFID. Preliminary results with this device suggest that the current pulse observed with the conventional FID is a composite of two signals, one of which is the time-of-flight delayed current of the charge carriers from the flame. (Author abstract)

04720

Tanner, Roger L. and Leonard Newman

THE ANALYSIS OF AIRBORNE SULFATE. J. Air Pollution Control Assoc., 26(8):737-747, Aug. 1976. 130 refs.

A critical review of literature reflecting the current state of analytical methodology for sulfate in airborne particles is presented. Methods for determination of total percent sulfate and total soluble sulfate are assessed. A more detailed review of the relatively new techniques for quantitative speciation of airborne sulfate then follows. Size distribution methodology and filter sampling difficulties relating to the collection of airborne sulfate-containing particles are enumerated. Experiments are suggested which use new, improved, and potentially applicable sulfate speciation techniques to obtain a better understanding of the generation, transport, transformation and removal processes that, in turn, determine the identity and concentrations of sulfate species in ambient air. (Author abstract)

04721

Floyd, John R. and Kenneth E. Knapp

FINE PARTICLE MEASUREMENT IN STATIONARY SOURCES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1976. 11 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-31.06.)

The state of the art of determining size distributions of particles in effluents is presented. Various methods are reviewed for applicability to stack testing, ease and cost of operation and analysis, size cut resolution and reproducibility, as well as potential for widespread future use and adaptability of each specifically to the measurement of small particles less than 3.0 micrometer in aerodynamic diameter (respirable fraction). Aerodynamic theory, inertial impaction, cyclonic separators, diffusion, electrical mobility, optical theory, and microscopy methods are reviewed in a language understood by scientists not directly associated with aerosol mechanics and particle sizing techniques. Pointed out is the need for more development of test methods specific for determining effluent stream concentrations of fine particles smaller than 3.0 micrometer in diameter. Preliminary tests indicate that such specificity is possible with inertial classifiers requiring no elaborate particle sizing equipment. Other recent developments in fine particle measurement are also discussed. (Author abstract)

D. AIR QUALITY MEASUREMENTS

[illegible]

Longley-Cook, Barbara Ann

AIR POLLUTION PARTICULATE MAPPING. Arizona Univ., Tucson, Dept. of Environmental Sciences, Thesis (Ph.D.). Ann Arbor, Mich., Univ. Microfilms, Inc., 1971, 89p. 58 refs.

An extensive survey of airborne suspended particulates using high volume air samplers was conducted in the Tucson metropolitan area. Determinations were made of the variations and fluctuations in pollutant concentrations with respect to time and space. Time considerations included diurnal, weekly, monthly, annual, and long range trends. Contour maps of the suspended particulates were constructed. The contours maintained a remarkable constancy in shape even though the levels of concentration changed from day to day, mainly as functions of meteorological parameters. The major sources of particulate matter were vacant land and strip-paved and unpaved roads. The latter contain very finely pulverized material which becomes airborne due to moving traffic and surface winds. A mathematical function consisting of the product of a spatially dependent function and a time dependent function was developed to calculate the suspended particulate levels in the Tucson atmosphere. A computer plotting program was written to perform the mapping. The constancy in the shape of the geographical distribution showed that pollution levels at all locations could be inferred from measurements at a few selected locations. (Author abstract modified)

[illegible]

Pasceri, Ralph E.

RESPIRABLE DUST CONTENT IN AMBIENT AIR. Environ. Sci. Technol., 9(7):655-657, July 1975. 18 refs.

The respirable dust content in the ambient air at a single near-urban location was determined by using a high-volume sampler and a cyclone separator to simulate the filtering action of the upper respiratory tract. The performance curve of the cyclone for unit density spheres closely matched an existing model for the filtering action of the nasal-pharynx and tracheo-bronchial regions. The experimentally determined ratio of the respirable dust weight to the total suspended particulate weight followed a normal distribution curve with a linear correlation coefficient of 0.9960 and an arithmetic average ratio of 0.50. Thus, on the average, approximately half of the suspended particulate mass at the sampling location was respirable. (Author abstract modified)

[illegible]

Pedace, Eduardo A. and Eric B. Sansone

THE RELATIONSHIP BETWEEN SOILING INDEX AND SUSPENDED PARTICULATE MATTER CONCENTRATIONS. J. Air Pollution Control Assoc., 25(5): 348-351, May 1975. 16 refs.

Experimental relationships between the mass concentration of suspended particulate matter and the optical density of particulates collected on paper tape (soiling index) were determined for the atmospheric aerosol and for aerosols of optical properties in field and laboratory tests. Simultaneous samples were obtained on membrane filters (for gravimetric analysis) and on Whatman No. 4 paper tape (for optical evaluation). Sampling procedures were adopted which ensured that the efficiency of sampling was the same in both cases. Consistent relationships between mass concentrations of suspended particulate matter and optical density expressed in terms of percent transmittance or percent reflectance were found for dispersions of coal, limestone, fly ash, and a coal-limestone mixture. For atmospheric aerosol samples collected on the roof of the Graduate School of Public Health, University of Pittsburgh, the relationship between mass concentration and percent transmittance or percent reflectance was linear over the range of values observed. The correlation coefficients were 0.93 (for concentration versus percent transmittance) and 0.89 (for concentration versus percent reflectance). (Author abstract)

[illegible]

Samuels, Harris J., SueAnne Twiss, Evan W. Wong, Harmon Wong-Woo, Peter K. Mueller, John A. Mage, and George J. Taylor

VISIBILITY, LIGHT SCATTERING AND MASS CONCENTRATION OF PARTICULATE MATTER. California State Air Resources Board, California Tri-City Aerosol Sampling Project and the California State Dept. of Public Health, Air and Industrial Hygiene Lab., 60p., July 1973. 13 refs.

Mass concentration aerosol data was collected using two-stage and high volume samplers, light scattering data was collected with an integrating nephelometer, and prevailing visibility was observed at sites in Los Angeles, Oakland, and Sacramento from Jan. 1970 to March 1971. Visibility and light scattering correlated highly, and relations between these parameters agreed with theory. Visibility was an important index of air quality; because there were operational difficulties in acquiring prevailing visibility data, the integrating nephelometer was recommended as a useful instrument for routine air quality monitoring. Mass concentration correlated with light scattering and visibility. Expressions relating mass concentration to light scattering were not precise, however, and preclude the use of mass concentration data to describe visibility. In all three urban locations, the mass fraction of particulate matter in the refined range, i.e., particles nominally smaller than 3 microns in diameter, ranged from an average of 51% to 77% and for 24-hour samples was essentially independent of variations in total mass concentrations. (Author abstract modified)

[illegible]

Hidy, G. M., P. K. Mueller, H. H. Wang, J. Karney, S. Twiss, M. Imada, and A. Alcocer

OBSERVATIONS OF AEROSOLS OVER SOUTHERN CALIFORNIA COASTAL WATERS. J. Appl. Meteorol., 13(1):96-107, Feb. 1974. 29 refs.

To characterize the background aerosol in air off the California coast, observations of suspended particles were made in the summer and fall of 1970 on San Nicolas Island (SNI), located about 130 km west-southwest of Los Angeles. Measurements of the physical and chemical properties of aerosols showed that the particles are a complex mixture of material from marine and continental origins. The Aitken nuclei population averaged [illegible]/cc, while particles more than 0.3 micron in diameter averaged [illegible]/cc. The average total mass concentration of aerosol evaluated from 22 samples was 30.6 micrograms/cu m, but the refined fraction defined as particles less than 3.5 micron in diameter was 40% of this level. The averages of the chemical analyses of 11 samples revealed that 11% of the aerosol sampled at a 940 m height above the ocean was sea salt, while approximately 20% evidently was soil dust, as indicated by silicates. Over 25% of the suspended material was sulfate, nitrate, or ammonium, which are constituents believed to be produced primarily from gaseous transformation reactions in the atmosphere. More than 20% of the sampled material was volatile in nature and is believed to be partly water. The ratio for the average chlorine to sodium concentrations from the analysis of 11 different samples was 2.4 compared with 1.8 for sea water. This high ratio supports other limited results for unpolluted air from offshore sources taken in this geographical region. The anomaly is believed to be linked with chemical reactions transforming gaseous chlorine compounds into condensed material. Comparison was made between the aerosol sampled on San Nicolas Island and the natural background contribution of the Los Angeles smog aerosol, as estimated elsewhere assuming contributions solely from sea salt and soil dust. The calculated background and the composition of the SNI aerosol were qualitatively similar, with the principal differences showing in calcium, zinc, sulfate, and nitrate. Further comparison with aerosol analyzed from Pasadena illustrated the major contribution of localized pollution to the chemical properties of the particles, particularly in the concentrations of manganese, Cu, bromine, iron, lead, SO4 ion, and NO3 ion. (Author abstract)

63199

Levaggi, D. A., J. S. Sandberg, M. Feldstein, and SueAnne Twiss

TOTAL ANTHROPOGENIC SUSPENDED PARTICULATE AS DERIVED FROM CHEMICAL ANALYSES OF CHLORIDE AND SILICATE IN HIGH-VOLUME SAMPLES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1974. 12 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-58.)

Extensive chemical analysis of suspended particulate undertaken by the Bay Area Air Pollution Control District for interpretation of total mass loading data and the detection of problem areas is presented. From high-volume samples taken with cellulose paper as the collection medium, analyses were performed for the five heavy metals and nitrate, sulfate, chloride, silicon, and total organics (loss on ignition at 550 C). Two constituents considered primarily non-anthropogenic, silicate and chloride, were evaluated from eight sampling sites. Data were derived from over 400 samples, one sample per week per site. The locations have diverse geographical backgrounds, although they lie in a common air basin. A 31-month average for chlorides ranged from 4.3 micrograms/cu m at San Francisco to 1.7 micrograms/cu m at Livermore some 40 miles inland. Inversely, the total silicates increased from 7.7 micrograms/cu m at San Francisco to 22.8 micrograms/cu m at Livermore. The silicate values peak strongly in the dry season, with individual 24-hour silicate component values greater than 60 micrograms/cu m at inland stations. Wind-generated dust from the bare hills of the Coast Range is the most probable source. Since the silicates and chlorides are primarily non-anthropogenic, they were excluded from the TSP values to give a total anthropogenic suspended particulate (TASP). The TASP values for the Bay Area show a geographic distribution in much closer conformity to visibility reduction and citizen complaint than do TSP values. (Author abstract)

63289

Faoro, Robert B.

TRENDS IN CONCENTRATIONS OF BENZENE-SOLUBLE SUSPENDED PARTICULATE FRACTION AND BENZO(A)PYRENE DETERMINED BY DATA FROM THE NATIONAL AIR SURVEILLANCE NETWORK. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1974. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-56.)

National trends in the benzene-soluble portion (BSO) of total suspended particulate matter in ambient air for 1960 through 1970 is presented. Trends for benzo(a)pyrene (BaP), a polynuclear aromatic hydrocarbon (PAH) present as a component of the BSO fraction, are presented for 1966 through 1970. Currently, data are not available for other PAH compounds and organics making up the remainder of BSO. Ambient concentrations of BSO decreased significantly nationwide for urban stations from 1960 to 1970. Out of 136 urban stations studied, 118 exhibited negative rank correlations with time, indicating the tendency at these stations of a decreasing trend in BSO concentrations. At half of the stations studied BSO showed a statistically significant downward trend. Decreases in urban BaP concentrations were also observed, but the limited data available prohibit a statistical evaluation of this change. The composite BaP average of the 32 urban stations dropped about 50% from 1966 to 1970. Nonurban BSO and BaP tend to show a decrease at the majority of stations studied from 1966 through 1970. The estimated national consumption of coal by small consumers for heating purposes decreased approximately 50% in the 1960-70 period, and this decreased use during this period is probably the principal factor contributing to the trends in BSO and BaP. A similar percentage decrease was observed in composite average BSO concentrations for urban stations. Local open burning ordinances and controls on incinerators instituted during this period are other possible factors contributing to the observed trends for these suspended particles. (Author abstract)

73577

Office of Air and Waste Management, Research Triangle Park, N. C., Office of Air Quality Planning and Standards

SPECIAL REPORT: TRENDS IN CONCENTRATIONS OF BENZENE-SOLUBLE SUSPENDED PARTICULATE FRACTION AND BENZO(A)PYRENE 1960-1972. Rept. EPA-450/2-74-022, 88p., Nov. 1974. 4 refs. NTIS: PB 238 802/AS

Trends in concentrations of benzene-soluble suspended particulate fractions and benzo(a)pyrene from 1960 to 1972 for data from the National Air Surveillance Network as well as other state, county, and local air monitoring programs are described. Trends in the benzene-soluble portion (BSO) of total suspended particulate matter are given for 1960 through 1970 for 136 urban and 29 nonurban sites. Trends for benzo(a)pyrene (BaP), a polynuclear aromatic hydrocarbon present as a component of the BSO fraction, are presented for 1966 through 1970 for 136 urban and 22 nonurban stations. Analyses of BaP and BSO data were also made for 14 urban locations for which data was available for 1971 and 1972. Ambient concentrations of BSO decreased significantly nationwide for urban stations from 1960 to 1970. The composite average of 32 urban stations for which complete data was available dropped consistently from 10.6 to 4.8 micrograms/cu in from 1968 to 1970. Decreases in urban BaP concentrations were also observed, but the limited data available prohibited a statistical evaluation of this change. The composite BaP average of the 32 urban stations dropped about 50% from 1966 to 1970. The decreasing trends in BSO and BaP appear to be continuing for the 17 sites with data available for 1971 and 1972. The nonurban stations for BSO did not show an apparent trend for 1966-1970. However, since 1966 the composite average has dropped from 1.3 to 1.2 micrograms/cu m in 1970. A very slight decline in the nonurban BaP composite average also was observed. Decreasing coal usage, local open burning ordinances, and automobile controls are probable factors contributing to the observed trends. (Author summary modified)

77290

Colovos, G., G. S. Wilson, and J. L. Moyers

PARTICLE SIZE DETERMINATION OF TRACE ELEMENTS IN URBAN AIR. Int. J. Environ. Anal. Chem., vol. 3:[illegible], 1974. 33 refs. (Presented at the Symposium on Recent Advances in the Analytical Chemistry of Pollutants, Halifax, Nova Scotia, Aug. 23-25, 1973.)

Airborne urban particulate matter was collected and fractionated according to size by cascade impactors situated about 10 m above ground and was then analyzed for the elements zinc, cadmium, copper, lead, aluminum, iron, manganese, calcium, and magnesium. The average mass median equivalent diameter of Cd and Pb was approximately 0.1 micron, and the average MMED s for Zn, Cu, Mg, and Fe were between 0.1 and 0.4 micron. The MMED s for Al, Ca, and Mn were between 0.5 and 0.8 micron. Examination of the elemental ratios (using Al as a reference element) revealed that Pb and Cd were about 1000 times more concentrated in atmospheric particulate matter than in average crustal material, and that in general the Pb/Al and Cd/Al ratios were inversely proportional to particle size. The Zn/Al and Cu/Al ratios of atmospheric particles were more or less independent of particle size and approximately 50 times higher than the corresponding ratios for crustal material. The ratios Fe/Al, Mn/Al, Ca/Al, and Mg/Al in all sizes of particulate matter were essentially identical to the average crustal material ratios. (Author abstract modified)

77627

Gilmore, Timothy M. and Thomas R. Hanna

APPLICABILITY OF THE MASS CONCENTRATION STANDARDS FOR PARTICULATE MATTER IN ALASKAN AREAS. J. Air Pollution Control Assoc., 24(6):535-539, May 1974. 17 refs.

High particulate matter concentrations were measured in several communities in Alaska using high volume air samplers. Because of these measurements, Anchorage and Fairbanks are classified Priority I for particulate matter. There are few large point sources of particulate matter in Alaska; the high concentrations that were measured due to entrainment of dust, either by natural means or by man s activities. The mean particle diameter in the Alaskan urban areas is approximately ten times that found in major metropolitan areas. The mean particle size increases with increasing mass concentration in these areas. Particulate matter concentrations in Alaska are highly dependent on natural phenomenon. The COH meter readings do not correlate with high volume air sampler measurements in Alaska. Combined sulfur dioxide and particulate matter data indicate little evidence of possible health hazard as defined in Air Quality Criteria for Particulate Matter. A possible method for relating high volume air sampler data to ambient air particulate matter standards based on size distribution was developed. (Author abstract modified)

77638

Willeke, Klaus and Kenneth T. Whitby

ATMOSPHERIC AEROSOLS: SIZE DISTRIBUTION INTERPRETATION. J. Air Pollution Control Assoc., 25(5):529-534, May 1975. 13 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 1974, Paper 74-[illegible].)

Measurements made with the Minnesota Aerosol Analyzing System in Denver, near Denver, and near Ft. Collins, Colo., are analyzed in relation to other several thousand size distributions measured in the other parts of the United States. The size distributions are multimodal. The Aitken nuclei range mode is a measure of freshly produced aerosols, the accumulation range mode indicates the degree of aerosol aging and the coarse particle mode gives information on the amount of wind-blown dust, sea spray, or mechanically produced aerosols such as fly ash. Air environments can be categorized into four kinds of backgrounds: clean continental, average content continental, urban district, and oceanic. The physical characteristics of these categories may be described by a limited number of parameters such as NT, VT, VS, and [illegible]. (Author summary modified)

77641

Wroblewski, Sandra C. and Thomas A. Kowalski

AN EVALUATION OF THE RELATIONSHIP BETWEEN AMBIENT SULFUR DIOXIDE AND WATER-SOLUBLE SULFATE CONCENTRATIONS IN THE CITY OF CHICAGO. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 18 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-15.7.)

Ambient sulfur dioxide and water-soluble sulfates were monitored at 10 trend sites in Chicago during 1968-1971 and 1974. A 75% decrease in ambient SO2 was observed from 1968 to 1974, while water-soluble sulfates declined only 35% during the same period, reflecting a 60% reduction in the SO2/sulfate ratio. Annual correlation coefficients for the 7 yr ranged from 0.61 for 1968 to 0.09 in 1974. Concentration gradient maps for 1968 and 1971 illustrate dissimilar SO2 and sulfate density patterns across the city. Seasonal characteristics of both pollutants indicated a general lack of congruity. No simple relationship appeared to exist between ambient SO2 and water-soluble sulfates in Chicago. (Author abstract modified)

77658

Rote, Donald M. and Lawrence E. Wangen

ANALYSIS OF SUSPENDED PARTICULATES IN THE CHICAGO AREA BY PARTICLE SIZE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., p. 1975. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-38.5.)

An aerosol sampling program in the Chicago area is described in which samples were obtained as a function of particle size (micron) at two or three urban and one non-urban site which is usually upwind of the city. The submicron and supermicron mass fractions depend significantly on wind speed, wind direction, and sampling location. A distinction in the wind speed dependence of the two particle modes is suggested by the data and supports theoretical expectations. The lower limit to the anthropogenic source contribution to the Chicago metropolitan area ranges from 6-19% of the total suspended particulates and that 50% or more of the observed total suspended particulates is due to sources located within the metropolitan area. The 5-month arithmetic average total suspended particulate, super-and submicron particulate concentrations at the non-urban site are 67.3, 49.3, and 27.4 micrograms/cu m respectively. The corresponding averages at one urban site are 93.7, 33.7, and 30.3 micrograms/cu m. (Author abstract modified)

77891

Sandberg, J. S., D. A. Levaggi, R. E. DeMandel, and W. Siu

SULFATE AND NITRATE PARTICULATES AS RELATED TO SO2 AND NOX GASES AND EMISSIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1975. 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-62.3.)

Five years (1969-1973) of sulfate and nitrate fractions were analyzed from high volume particulate samples at 8 stations in the San Francisco Bay Area. The sulfate and nitrate particulates closely track simultaneous emission inventory data, while sulfur dioxide (SO2) and nitrogen oxides (NOx) gas data vary more widely in response to local sources and to meteorological factors. The area-wide five year mean for sulfates is 7.98 micrograms/cu m, slightly above the remote nonurban sulfate background level. The similar five year nitrate mean, 7.79 micrograms/cu m, is well above the national urban average. A study at 3 stations in 1973 indicated that the sulfates are primarily in the fine (less than 0.65 micron) size range. A regression line was fitted to all station annual averages of sulfate versus SO2. Compared with a recent Environmental Protection Agency study for northeastern cities, the background is less than one quarter as high, but the slope is twice as great, best explained by photochemical species and processes accelerating conversion. The nitrate and NOx data yielded more complex and localized relationships. The generally low sulfate levels indicate the effectiveness of SOx control. The relatively high nitrate levels suggest that control strategy might place greater emphasis on NOx emissions. Distinct groupings of the higher sulfate levels in the north and nitrate levels in the south suggest that sub-basins requiring differing control emphasis may exist. The sulfate and nitrate data may serve as a basis for development of improved particulate standards. (Author abstract modified)

78417

Neustadter, H. E., R. B. King, and J. S. Fordyce

ELEMENTAL COMPOSITION OF SUSPENDED PARTICULATES AS FUNCTIONS OF SPACE AND TIME IN CLEVELAND, OHIO. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1975. 17 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-38.1.)

Neutron activation and emission spectrometric analyses of over 750 24-hour airborne particulate samples collected at 16 sites in Cleveland, Ohio from August 1971 to October 1973 were performed. The data were analyzed with the aid of pairwise correlation statistics, selective data plotting, and cluster analysis. Bromine and lead, taken as a pair, showed relatively low variability and were similarly enriched when normalized to silicon as compared with typical earth crustal abundances. Lanthanum, samarium, europium, dysprosium, and thorium generally exhibited the same spatial distribution as aluminum, silicon, titanium, selenium, and vanadium. As a group they were not highly variable and did not show any enrichment relative to earth crustal abundance. Iron, chromium, and cobalt jointly exhibited a slightly more variable distribution pattern and showed possible enrichment. Copper, magnesium, and antimony were significantly enriched, and each possessed its own distinctive distribution pattern. Possible industrial or fusion sources of particulates in the area were related to the various enrichment patterns observed. (Author abstract modified)

81645

Kleinman, M. T., T. J. Kneip, and M. Eisenbud

SEASONAL PATTERNS IN AIRBORNE PARTICULATE CONCENTRATIONS IN NEW YORK CITY. Atmos. Environ., 10(1):9-11, 1976. 8 refs.

Total suspended particulate measurements over New York City for the 3-year period 1972-1974 were analyzed for possible seasonal patterns. The measurements were normalized for the effects of wind speed and the height of the atmospheric mixing layer. Emissions were increased during the winter months, presumably due to the combustion of oil for space heating. This source appeared to contribute an average of 40% of the total suspended particulate loading during the winter and about 10-20% of the annual average total suspended particulates. (Author abstract modified)

82790

Feeney, P. J., T. A. Cahill, R. G. Flocchini, R. A. Eldred, D. J. Shadoan, and T. Dunn

EFFECT OF ROADBED CONFIGURATION ON TRAFFIC DERIVED AEROSOLS. J. Air Pollution Control Assoc., 25(11):1145-1147, Nov. 1975. 10 refs.

Aerosols present upwind and downwind of freeways in the Los Angeles Basin were collected by Lundgren impactors with distributions over five particle size ranges in an effort to determine the effect of roadbed configuration on traffic-derived aerosols. The contribution of freeway traffic to total airborne particulate load was established by subtracting the local background which was measured with an upwind sampler from the values obtained by downwind samplers on a size by size and element by element basis. The contribution of traffic to ground lead correlated reasonably well with estimates derived from automotive and roadbed expenditure rates. Traffic-derived aerosols, normalized to vehicular flow, were considerably lower in most at locations downwind of depressed roadbed configuration than they were at either raised or at-grade configurations. A line source model combined with literature values for emitted lead produced good agreement with results obtained for the at-grade configuration. (Author abstract modified)

83156

Ursenbach, Wayne O., A. Clyde Hill, William H. Edwards, and Steven M. Kunen

ATMOSPHERIC PARTICULATE SULFATE IN THE WESTERN UNITED STATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1976. 11 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-7.5.)

In order to understand the nature of the particulates responsible for light scattering and hence reduction in visibility, electron microscopy was used to analyze particulates collected in the field to obtain the particle size distribution and types of atmospheric particles. From these data using Mie theory the influence on light scattering and hence visibility reduction was calculated. This paper reports results particularly as they pertain to sulfate particles in the arid Western United States. These particles are believed to be predominantly ammonium sulfate, although other sulfate species and ammonium nitrate may be present. A persisting environmental concern with proposed energy development is the reduction of visibility in the scenic Western United States due to industrial pollution. The rule making for prevention of significant deterioration was enacted in part to this purpose to prevent industrial particulates from spoiling this area. In spite of these efforts, visibility degradation has been suspected but, except in local situations, no clear definition of atmospheric particulates in any one area has been obtained. Conventional particulate concentrations as measured by hi-vol samplers and to some extent with cascade impactors have not been adequate to assess this problem. Particulate concentrations will continue to be highly variable due to the influence of wind action on dry soil surfaces and limited measurements have not shown the visibility correlation with mass concentrations observed in urban communities. Atmospheric submicron sulfate particles, predominantly ammonium sulfate, were observed everywhere samples were collected. In remote areas mass concentrations on a weekly basis ranged from 0.1 - 1.0 micrograms/cu m, predominantly less than 0.1 micron diameter. Limited studies of conversion of sulfur dioxide to atmospheric sub-micron sulfate particulates in the Four Corners Power Plant plume showed a rate of conversion less than 1%/hr. Extinction coefficients, calculated for the various particulates observed in atmospheric particle samples, were used to estimate visual range. On a mass basis submicron sulfate particulates were about twenty times more effective than fly ash and soil dust in reduction of visibility, accounting for 25-50% of the extinction coefficient due to suspended particulates at the normally low ambient humidity. (Author abstract)

04731

Cowherd, Charles, Jr., Christine Guenther, and Charles C. Masser

METHODOLOGY FOR AN HOURLY EMISSIONS INVENTORY OF FUGITIVE DUST SOURCES FOR THE RAPS PROGRAM. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1976. 12 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-5.1.)

The methodology that was used in developing an hourly fugitive dust emissions inventory for the Metropolitan St. Louis Air Quality Control Region as a part of the Regional Air Pollution Study (RAPS) is presented. The information is directed toward those interested in inventorying sources of fugitive dust emissions, in particular, unpaved roads, agricultural land tilling, wind erosion of agricultural land, construction sites, aggregate storage piles, and unpaved airstrips. For each of approximately 2000 RAPS grid areas, data were compiled on annual emissions of fugitive dust. This required, in addition to basic emission factors adjusted for local climatic and surface conditions, annual measures of source extent (vehicle miles traveled on unpaved roads, acres of land tilled) for each grid area. Finally, hourly apportioning factors were derived to account for emissions variations by hour of the day, day of the week, and season of the year. Results include county totals of annual source extent and annual emissions for each source category. Unpaved roads and wind erosion from agricultural tilled land account for more than 80% of the total fugitive dust emissions within the St. Louis area. Fine particle emissions from fugitive dust sources in the St. Louis area were found to comprise 10% of the total particulate emissions. (Author abstract)

04703

Pace, Thompson G.

NATIONAL ASSESSMENT OF THE URBAN PARTICULATE PROBLEM. VOLUME II. PARTICLE CHARACTERIZATION (FINAL REPORT). Environmental Protection Agency, Research Triangle Park, N.C., Contract EPA 68-02-1376, Task Order 18, Rept. GCA-TR-76-25-G(2), Rept. EPA 450/3-76-025, 100p., July 1976. 3 refs.

Data concerning the physical and chemical properties of the particulate matter collected on selected hi-vol filters obtained from existing filter banks for 14 cities are presented. Most of the analysis was by optical microscopic examination of the 445 samples obtained. In addition, there was a detailed physical examination of 15 of the filter samples, chemical analysis of 8 samples, and particle size distribution analysis (as a function of particle type) for 4 samples. Meteorological observations for the sampling days are also provided. The cities studied were: Denver, Birmingham, Baltimore, Philadelphia, Washington, Chattanooga, Oklahoma City, Seattle, Cincinnati, Cleveland, San Francisco, Miami, St. Louis, and Providence.

E. ATMOSPHERIC INTERACTION

11801

Yen, K. T.

METEOROLOGICAL AIR POLLUTION MODELING. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1971. 14 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-9.)

An approach to the development of a meteorological air pollution model and a scheme for pollution monitoring and forecasting for an urban region are presented. Two dynamic equations governing the transport and diffusion of the pollutants are derived: the mesoscale diffusion equation controlling the pollutant distribution in an urban area and the macroscale diffusion equation which can be used to find the transport of pollutants from one metropolitan area to another. To be consistent with the two averaging scales for the large-scale and mesoscale motions, the same scales should be used as the basic sampling or averaging scales for the pollutant concentrations. The two scales in time are of the order of several minutes and two hours. The characteristics of Gaussian models are examined. An example is given to show that only for mesoscale winds of a specific type can the Gaussian model be modified to include the effects of such winds in the vertical standard deviation of the concentration distribution. The proposed monitoring network has a surface station separation of a few kilometers, and is found to be compatible with the computational grid for mesoscale prediction. Such a network appears to have the necessary density for surveillance of pollutant emissions in the industrial area. In the scheme, a procedure for carrying out the prediction of large-scale winds, mesoscale winds, and pollutant distribution is given, and the required computing time estimated. (Author abstract modified)

33146

Vehrs, G. I.

DISPERSION OF COAL PARTICLES FROM STORAGE PILES. Ont. Hydro Res. Quart., 23(3):11-16, 1971. 3 refs.

The dispersion of dust from a large coal pile has been examined and a theory developed for calculating the deposition at distances of a few thousand meters. Three phases are involved in the process: generation of airborne dust; dispersion by eddy diffusion; and deposition by gravitational settling and precipitation washout. The amount of material deposited is a function of distance, wind speed, atmospheric stability, emission rate, and particle size. The dust raised by vehicular movement was estimated from concentration measurements made close to the pile surface, and the theory was used to calculate depositions based on this value. Results suggest that, on rare occasions, coal-dust depositions could be a major source of dustfall. At times when such episodes could occur, it is important that precautionary measures, such as the spraying of the pile surface with water, be undertaken. (Author abstract modified)

14683

Biggs, W. Gale, Robert G. Allen, Loren W. Crow, Elmer L. Herlind, and Robert G. Larson

AN ASSESSMENT OF THE COMBINED EFFECTS OF AIR POLLUTION BY THE MAJOR POWER PLANTS IN THE SOUTHWEST UNITED STATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1972. 1 ref. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-130.)

Results of a joint effort by several separate consulting organizations to assemble a unified report concerning the total impact on the environment of the southwest United States (the area including eastern Utah, western Colorado, northwestern New Mexico, northern Arizona, and southern Nevada) by the large coal-fired power plants in the region, are presented. An investigation was conducted only at those plants which were already in operation, under construction, or for which definite plans have been made. The major effort was an attempt to describe the meteorology and possible air movement or exchange during periods of restricted dispersion conditions. The area in question can be broken into several great air sheds. The meteorological interaction between air sheds during stagnant conditions is insignificant. There is no significant interaction of power plant effluents between great air sheds. Stagnation may be as long as 11 days in this area. However, each separate air shed should be evaluated further since the degree of stagnation, and its consequences, will vary between the different locales. Even when stagnation occurs, concentrations of emissions do not build continuously but reach an equilibrium, the magnitude of which is determined by emission rate and atmospheric reactivity of the pollutant. (Author conclusions)

11850

Hagen, L. J. and N. P. Woodruff

AIR POLLUTION FROM DUST STORMS IN THE GREAT PLAINS. Atmos. Environ., 7(3):323-332, March 1973. 8 refs.

Great Plains states are adopting air pollution regulations to limit particulate concentrations. Because little information is about dust storms, an important source of particulates in those states, hourly observations of the weather on dusty days during the 1950's at 17 weather stations were analyzed. Wind direction was southerly, and windspeeds were usually 8.0-11.6 m/sec; relative humidity was less than 30 to 50% of the dusty hours. During periods of low precipitation, most Great Plains locations had a significant number of hours with dust. The study revealed that the median annual hours of dust was 87, but more than 150 dusty hours were recorded in 30% of the reports. Though urban air pollution episodes last longer than dust storms, dust storms have larger particles and higher particulate concentrations. The average dust storm lasted 6.0 hr, and median dust concentration was 4.81 mg/cu m. Because of high concentrations of coarse particles in dust storms, air pollution laws in the Great Plains probably should specify particulate size distributions to which various sections of the laws apply as well as limits on particulate concentrations. (Author abstract modified)

14381

Nevers, Noel de and J. Roger Morris

ROLLBACK MODELING--BASIC AND MODIFIED. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 38p., 1973. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-139.)

The rollback or proportional model is widely used in pollution control calculations and included in the guidelines for preparing and evaluating state implementation plans. It assumes that the concentration of any long-lived pollutant at any point is equal to the background concentration of that pollutant plus some linear function of the total emission rate of the pollutant in the area which influences the concentration at that point. However, simple rollback has no experimental basis, and its theoretical basis is restricted to very unusual situations, i.e., situations involving perfect atmospheric mixing in the area of interest, or in which all emitters make the same percentage reduction. Four modified forms of rollback are derived. The first extends basic rollback to multiple categories of sources; the second extends this multiple source version to include the effects of average stack heights for the various categories; the third includes the radial distance from source to receptor; and the fourth adds wind direction frequency. All of these models are derived from the same formula, with each one differing from the others only in the number of categories into which the area emissions are divided and the method of estimating the contribution of a unit emission rate from a category to the concentration at a particular point. Rollback modeling should begin with the basic equation and proceed to the form that is justified by plausible assumptions and data availability. In most cases, the third or fourth model would be most appropriate. They may play a useful role as intermediate tools between the very simple, hand calculated rollback formula and the more advanced and complex computer models now in use. (Author abstract modified)

15295

Fitzjarrald, D. E.

A FIELD INVESTIGATION OF DUST DEVILS. J. Appl. Meteorol., 12(5):808-813, Aug. 1973. 9 refs.

The interaction between dust devils and their environment was investigated in a field observation program conducted at El Mirage, California. The outputs of sensors designed to measure vertical vorticity were recorded, together with those of cup anemometers. Analysis of the data indicated that there is no correlation between vorticity measured at a point and the direction of rotation of nearby dust devils. Tangential velocity, vertical velocity, and temperature were determined in 11 dust devils. Maximum vertical velocities were about one-tenth of the tangential velocities, indicating that the boundary layer height extended well above the 2 m measurement height. The data are thus unlikely to reveal a cooler area at the very center of the vortex due to downward motion. (Author abstract modified)

16092

McAdie, H. G. and D. R. A. Gillies

THE OPERATIONAL FORECASTING OF UNDESIRABLE POLLUTION LEVELS BASED ON A COMBINED POLLUTION INDEX. J. Air Pollution Control Assoc., 23(11):941-944, Nov. 1973. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami Beach, Fla., June 1972, Paper 72-165.)

Several air pollution indices have been developed for control action and public information. The majority of these are based upon some combination of sulfur dioxide and particulate matter levels, since epidemiological studies indicate a relationship between severity of health effects and these constituents. The application of one such index, in conjunction with synoptic meteorological forecasting, to an operational program for forecasting pollution potential in the Sarnia, Ontario, petrochemical complex is described. The program was developed in conjunction with the Lambton Industrial Society. This system has operated for over 3 years with approximately a 70% accuracy of predicting adverse situations. The performance of this program indicates that meteorological forecasts can be used successfully to provide major sources with the advance information necessary to effect any additional control measures relevant to their individual operations. (Author abstract)

17132

Sehmel, G. A. and F. D. Lloyd

INFLUENCE OF SOIL RESUSPENSION ON THE AIRBORNE PARTICLE SIZE DISTRIBUTION. In: Pacific Northwest Laboratory Annual Report for 1973 to the USAEC Division of Biomedical and Environmental Research. Volume II: Physical Sciences. Part 1. Atmospheric Sciences. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., p. 1-5, April 1973. 3 refs. NTIS: BNWL-1751 PT1, UC-53 Meteorology

The airborne particle size distribution function of resuspended soil was determined as a function of particle diameters from 1 to 130 micron and sampling heights from 0.3 to 30 m. An apparent lower limit was determined for the size distribution function. Soil resuspension can cause relatively high soil injection rates into the atmosphere which increase the magnitude of the size distribution function above the lower limit. The soil resuspension rates are a direct function of the hours of high wind speed occurring during dusty time periods. However, the resuspension rates must also be a function of the persistence of these high winds since less resuspension occurs for the same total hours of high winds when these hours are accumulated over a longer time period. (Author abstract)

17133

Slinn, W. G. N.

INITIAL RESUSPENSION MODELS. In: Pacific Northwest Laboratory Annual Report for 1973 to the USAEC Division of Biomedical and Environmental Research. Volume II: Physical Sciences. Part 1. Atmospheric Sciences. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., p. 5-15, April 1973. 10 refs. NTIS: BNWL-1751 PT1, UC-53 Meteorology

The resuspension of aerosol particles from the earth's surface was studied theoretically. For friction velocity greater than or approximately equal to 30 cm/sec, horizontal wind fluctuations can dislodge most sub-millimeter particles from dry soil. This suggests that the soil particle size distribution is the controlling factor of the airborne particle size distribution in the near-surface layer. Above the surface layer, the convective diffusion equation is incapable of explaining experimental data. The resuspension of the material into the forced convection layer depends almost entirely on the statistical properties of the turbulence. A statistical approach based on the probability distribution of vertical wind speeds is explored; the observed wind speed data does correctly describe the size distribution of large, resuspended particles. Directions are indicated for future theoretical and experimental studies. (Author abstract modified)

57154

Sehmel, G. A. and M. M. Orgill

RESUSPENSION BY WIND AT ROCKY FLATS. In: Pacific Northwest Laboratory Annual Report for 1972 to the USAEC Division of Biomedical and Environmental Research. Volume II: Physical Sciences. Part 1. Atmospheric Sciences. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., p. 15-23, April 1973. 9 refs. NTIS: BNWL-1751 PT1, [illegible] Meteorology

Airborne plutonium concentrations were related to meteorological parameters at Rocky Flats to increase understanding of environmental resuspension processes. The meteorological data includes hourly wind speed and direction and maximum daily wind gust at the tower site. The anemometer was located 60 ft above ground and .75 mi west of the oil spill area. Despite low activity levels and smoothing of variability in airborne concentrations performed by sampling over relatively long periods of time, the reported data were useful in defining some dependencies of resuspension on meteorological parameters. The maximum resuspension factors, for scoping estimates, were in the range of 10 to the -5th power to 10 to the -9th power/m for 6 hr, 48 hr, and weekly air samples collected near the east security fence and at 2.3 mi from the plant. Since the airborne concentration should also be related to an upwind and not a local surface contamination, the airborne concentrations at one sampling station were related to wind speed for July 1970 to Jan. 1971. The model for wind-caused plutonium resuspension at this sampling station was the average airborne concentration in units of fCi/cu m equals 0.45 times the average west and southwest wind speed to the 2.1 power in m/hr. The linear correlation coefficient for the model was 0.89. The theoretical model was proportional to wind speed to the 3.0 power rather than the experimental wind speed to the 2.1 power. The model predicts that total activity in each hourly time period is equal to the plutonium fallout activity in fCi/cu m during the time period plus 0.1 plus 0.45 (mph) to the 2.1 power.

58139

Hutcheson, Main R. and Franklin P. Hall, Jr.

SULFATE WASHOUT FROM A COAL FIRED POWER PLANT PLUME. Atmos. Environ., 8(1):23-28, Jan. 1974. 9 refs.

Sulfate washout data was collected near a coal-fired generating station, and the seasonally-averaged sulfate concentration in rainwater was converted to sulfate washout at 17 sampling sites located in an area one to 16 miles from the site. Sulfate aerosol scavenging did not account for the washout pattern observed, and known characteristics strongly suggested that sulfur dioxide scavenging by rain was the primary washout mechanism. An empirical expression for the SO2 washout coefficient based upon knowledge of SO2 scavenging was developed and used as an aid in analyzing the data. The study indicated that the relative importance of sulfate aerosol and SO2 scavenging in the very complex sulfur washout process was significantly influenced by the background acidity of the rain, the height of the pollutant source, and the rainfall rate. (Author abstract modified)

59613

Hobbs, P. V., H. Harrison, and E. Robinson

ATMOSPHERIC EFFECTS OF POLLUTANTS. Science, 183(4128):909-915, March 8, 1974. 18 refs.

The influence of various air pollutants on the atmosphere is considered, and criteria are proposed for the classification and control of such pollutants. The dispersion cycle of a pollutant through the atmosphere depends on the nature of the source, its dilution and dispersion by atmospheric motion, and the removal or scavenging of the pollutant by atmospheric and surface processes; and the evaluation of a new material as a potential source of air pollution must taken into account the material at the various stages in its manufacture and disposal. Aerosols appear to be the principal agents by which pollutants affect weather and climate, and they are most likely to act by influencing the structure and distribution of clouds. They may also influence the vertical temperature structure of the atmosphere which in turn influences mixing and dispersion and the buildup of aerosols. Inadvertent modification of the microstructure and distribution of clouds will not only affect precipitation processes but also radiative properties. Water vapor, carbon dioxide, and ozone each significantly affect the heat transfer of outgoing thermal radiation from the earth's surface. Molecules which are likely to interact strongly with photochemical oxidation sequences in the air are: photoactive molecules which may form atomic oxygen, hydroxyl radical, atomic hydrogen, or halogen atoms in ultraviolet or visible radiation; free-radical scavenging molecules; olefinic molecules, especially those with conjugated double bonds; molecules with aromatic and heterocyclic rings; molecules that form long-lived triplet states by absorption near 3000-4000 A; and molecules with strained rings.

60270

Gatz, Donald F.

METROMEX: AIR AND RAIN CHEMISTRY ANALYSES. Bull. Am. Meteorol. Soc., 55(2):92-93, Feb. 1974. 3 refs.

Causes of inadvertent precipitation modification in the St. Louis area were studied by using tracers to measure particle removal efficiencies and to follow particles ingested in convective storm updrafts and by measuring trace element concentrations in rain and air sampled upwind and downwind of the city to determine where and when urban pollutants appear in downwind precipitation. Tracers were released from various surface locations on 9 days to investigate whether urban aerosols could reach cloud level in time to influence near-downwind precipitation; deposition patterns showed that materials released near the ground were capable of entering convective clouds and depositing in rain within short times and distances from the release point. Trace element measurements showed that mean concentrations in both air and rain increased by at least 50% from upwind to downwind of the city. For each element the relative concentration increase in the rain matched or exceeded that in the air, confirming the fact that urban aerosols are quickly incorporated into and deposited by rain.

61125

Beard, K. V. and S. N. Grover

NUMERICAL COLLISION EFFICIENCIES FOR SMALL RAINDROPS COLLIDING WITH MICRON SIZE PARTICLES. J. Atmospheric Sci., 31(2):543-550, March 1974. 24 refs.

Numerical calculations are conducted to determine collision efficiencies between small raindrops and micron-size particles based on a numerical description of the axisymmetric steady-state flow about a rigid sphere for drop Reynolds numbers 1, 10, 30, 100, 200, and 400. The particle is assumed to move with a Stokes-Cunningham resistance to motion in the unperturbed flow of the drop. The results for drop radii between 40 and 500 micron and particle radii greater than or equal to 1 micron, the ratio of the latter to the former being less than or equal to 0.1, are intermediate to previously calculated collision efficiencies for the potential and viscous flow limits and do not follow the Langmuir interpolation formula. Comparison with experimental results shows good agreement when electric forces are unimportant. A new interpolation scheme is presented for the present results as well as for the potential flow case for larger raindrops which may be evaluated either graphically or by computer for a range of atmospheric conditions of [illegible] mb and 0-30 C. (Author abstract modified)

[illegible]

Hanna, Steven R.

RELATING EMISSIONS TO AIR QUALITY IN TENNESSEE. National Oceanic and Atmospheric Administration, Oak Ridge, Tenn., Atmospheric Turbulence and Diffusion Lab., ATDL Contribution File 90, 10p., March 1974. 8 refs.

Average annual emissions of suspended particles, sulfur dioxide, and carbon monoxide from each of the 95 counties in Tennessee during 1970 are compared with observed air quality. Due to the location of air monitoring instruments close to large local sources, the readings of these instruments are found to be usually not representative of regional air quality. In order to adequately test regional dispersion models in Tennessee, it is necessary to install additional air monitoring stations that are not influenced by large local sources. The variations of county pollutant concentrations across the state are generally within a factor of three, while the variations of county pollutant emissions are generally over several orders of magnitude. The wind speed therefore strongly controls the day to day background level of air pollution in the state. (Author abstract)

67180

Spiegler, David B., Elliot Newman, and Robert E. Bailey

AMBIENT POLLUTANT CONCENTRATIONS AROUND POWER PLANTS AS A FUNCTION OF METEOROLOGICAL CONDITIONS. Preprint, Air Pollution Control Assoc., 18p., 1974. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-7.1)

Sulfur dioxide, nitrogen oxides, and total suspended particulates were measured by real-time Air Monitoring Analysis and Prediction (AIRMAP) systems near power plants along the North Shore of eastern Massachusetts and in the Hudson River Valley in N. Y. Two meteorological towers in the Hudson River Valley measured wind direction, wind speed, temperature, and temperature difference. Pollutant concentrations were influenced by the meteorological conditions and the large scale atmospheric conditions which can be predicted a day in advance. Therefore, it would be technically feasible to develop reliable air quality predictions which could be used as the basis for an intermittent fuel control strategy in the power plants. Hourly average concentrations varied in some cases by more than two orders of magnitude, depending upon atmospheric conditions. The highest SO2 conditions occurred in the winter when high pressure systems moved to the southwest resulting in southwest winds and a stable atmosphere over the region, when a polar anticyclone was over the region, and when unstable and neutral conditions with gusty winds averaging greater than 10 mph occurred. Stable atmospheres were associated with higher than average NOx readings, while strong winds were associated with lower NOx readings. Diurnal NOx variations correlated with traffic.

67179

Idso, Sherwood B.

TORNADO OR DUST DEVIL: THE ENIGMA OF DESERT WHIRLWINDS. Am. Scientist, 62(5):530-541, Sept.-Oct., 1974. 43 refs.

The enigma of desert whirlwinds is reviewed in terms of possible mechanisms for their development, with typical mechanisms being illustrated for tornados and dust devils. Several mechanisms are cited that may induce concentrated, vertical vital motion in the vicinity of desert dust storm frontal boundaries, including the interaction of a thunderstorm's cold-air outflow with a topographic disturbance. The interaction at thunderstorm outflow boundaries involving the formation of a strong convergent local wind field might also be an explanation for vortices as opposed to differential temperature-induced convection. Questions concerning vortices which remain unanswered involve: whether they occur in front of or behind the surge head and whether their rotation is cyclonic or anticyclonic, the possibility of a dynamic connection with the cloud base, the probability of vortex occurrence downwind from significant topographic disturbances, the frequency of twin funnels, and the frequency of small subsidiary vortices being associated with larger vortex wind fields.

[illegible]

Whelpdale, D. M.

PARTICULATE RESIDENCE TIMES. Water, Air, Soil Pollut., 3(3):293-300, Sept. 1974. 10 refs.

Examination of suspended particulate concentration data from a year-long, regional air quality study of a portion of the Great Lakes area revealed that depletion of particulates occurred during extended periods of travel over water surfaces. Based on particulate concentrations and meteorological measurements, residence times of background regional particulate matter were between 5 and 16 hr in the region. Using a simple model for the deposition of particulate matter into the lakes, deposition rates ranging from 0.2 to 1.9 micrograms/sq m/sec were found. This results, for example, in an estimated 150 metric tons of material being deposited into Lake St. Clair, with an area of 1270 sq km, during a 24-hour period. (Author abstract modified)

[illegible]

Easter, Richard C. and Peter V. Hobbs

THE FORMATION OF SULFATES AND THE ENHANCEMENT OF CLOUD CONDENSATION NUCLEI IN CLOUDS. J. Atmospheric Sci., 31(6):1586-1594, Sept. 1974. 24 refs.

A mathematical model is developed for predicting the production of ammonium sulfate by oxidation of dissolved sulfur dioxide in cloud droplets of small-amplitude wave clouds and the resulting enhancement of cloud condensation nuclei released from the clouds on evaporation. The condensational growth of the droplets formed on 73 initial cloud condensation nuclei sizes is considered simultaneously with the production of sulfates in the droplets of an air parcel moving through a wave cloud via the Scott-Hobbs mechanism. Significant increases in the concentrations of cloud condensation nuclei active at 0.5% supersaturation can be produced by SO2 oxidation in wave clouds with short flow-through times (4 min) and with concentrations of SO2 and ammonia typical of unpolluted air (1 and 3 ppb, respectively). The sulfate production decreases as the SO2 concentration rises above 10 ppb due to the limited buffering capacity of the NH3. In-cloud production of ammonium sulfate can probably explain previous observations of higher than ambient cloud condensation nuclei concentrations in air from evaporating clouds, with the ammonium sulfate production in clouds being sufficiently fast to account for the major worldwide source of these particles. (Author abstract modified)

60084

Roberts, Paul T. and Sheldon K. Friedlander

CONVERSION OF SO2 TO AMBIENT PARTICULATE SULFATES IN THE LOS ANGELES ATMOSPHERE. Preprint, National Inst. of Health, Research Triangle Park, N. C., National Inst. of Environmental Health Science and Environmental Protection Agency, Research Triangle Park, N. C., Office of Research and Development, 16p., 1974. 11 refs. (Presented at the Health Consequences of Environmental Controls: Impact of Mobile Emissions Controls, Durham, N. C., April 15-18, 1974.)

Gas phase and particulate phase sulfur were determined at various locations in the Los Angeles basin to determine atmospheric conversion rates and mechanisms. A new technique was developed for the measurement of particulate sulfur. From measurements of the particulate to gas phase sulfur ratio near the major stationary sources and far downstream and from estimates of travel times determined by air trajectory analysis, it is possible to estimate gas-to-particle conversion rates for sulfur. Such calculations show that automobiles presently contribute a major part of the total sulfur as measured at a receptor site such as Pasadena, while contributing only a small amount to the particulate sulfur loading. The introduction of oxidation catalyst-equipped vehicles may add significantly to the particulate sulfur at downwind receptor sites; predictions of particulate sulfur concentrations near freeways show substantial increases due to such vehicles. (Author abstract)

60100

Newman, J. E., M. D. Abel, W. A. Bruns, and R. J. Yost

SOME ATMOSPHERIC TRANSPORT CHARACTERISTICS OF SUSPENDED PARTICULATES AND ASSOCIATED TRACE CONTAMINANTS AROUND THE SOUTH END OF LAKE MICHIGAN. Preprint, Purdue Univ., West Lafayette, Ind., Dept. of Agronomy and Purdue Univ., West Lafayette, Ind., Dept. of Bionucleonics, 11p., 1974. 5 refs.

Selected daily isopleths for total suspended particulate and associated trace contaminants around the south end of Lake Michigan are analyzed for atmospheric transport characteristics. It is possible to clearly isolate certain mesoscale atmospheric transport characteristics from single-day isopleth analysis. But, single-day isopleth analysis reveals only area source pollution levels, not point sources. Point source identification from atmospheric transport patterns can therefore be achieved only from accurate hourly meteorological data, in conjunction with known point source inventory strengths, and under environmental conditions that essentially eliminate refloatation from terrestrial surfaces. (Author abstract)

60411

Orgill, M. M., G. A. Sehmel, and T. J. Bander

REGIONAL WIND RESUSPENSION OF DUST. In: Pacific Northwest Laboratory Annual Report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 3 Atmospheric Sciences. Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., Atomic Energy Commission Contract AT(45-1)-1830, Environmental and Earth Sciences Dept. UC-11, p. 216-219, April 1974. NTIS: BNWL-1850 PT3

The natural wind-caused airborne dust loadings over the country were determined through meteorological data. The National Weather Service reporting observations of dust and visibility were used to infer the approximate frequency and dust loadings for resuspension periods. Dust parameters for the period 1953-1970 are presented for the Hanford area. The total dust hours were 475 and the total dust days were 145. There were 130 dust storms which ranged in duration from 1-16 hr. The hours of dust occurrence, average visibility, and estimated average dust concentration are tabulated as a function of wind direction and speed. The average dust concentration during dusty period was approximately 7 mg/cu m.

60414

Abel, Michael D. and James E. Newman

AIR QUALITY CHANGES ASSOCIATED WITH THE ATMOSPHERIC TRANSPORT OF TOTAL SUSPENDED PARTICULATE IN AND AROUND CHICAGO. Preprint, Purdue Univ., West Lafayette, Ind., Agricultural Experiment Station, 24p., 1974. 5 refs.

An analysis is made of the wind directional effects on the atmospheric transport of total suspended particulate in and around the city of Chicago. Daily and annual estimated values in micrograms/cu m are reported for total suspended particulates advected into Chicago from surrounding industrial, urban, and rural areas. Using 8 years of data in the analysis, estimates are given for the mean annual values of total suspended particulate advection from northwest Indiana into Chicago, Ill. Some estimates are given for corresponding mean daily values of total suspended particulate advection into Chicago as well. The estimated maximum value of total suspended particulate increase due to advection from Indiana into Chicago was computed as 4% for the 8-year average. (Author abstract modified)

60419

Cahill, Thomas A. and Patrick J. Feeney

CONTRIBUTION OF FREEWAY TRAFFIC TO AIRBORNE PARTICULATE MATTER (FINAL REPORT). California Univ., Davis, Crocker Nuclear Lab., California Air Resources Board Contract ARB-502, Proj. 4B-184-7, Rept. ARB-R-502-73-[illegible], Calif. Univ. Rept. UCD-CNL-169, 163p., April 1974. 18 refs. NTIS: PB 233 217

The total particulate matter burden contributed by motor vehicle traffic was determined by analysis of size-segregated aerosol samples collected upwind and downwind of cut, fill and at-grade freeway sections. Elemental analyses of the samples were performed to determine the selective contribution of exhaust emissions, roadway abrasion, tire wear, and degradation of moving parts. The results were combined with weather data to determine dispersal patterns and the contributions from other sources. In areas adjacent to the downwind side of freeways, the particulate burden was greatest for fill sections, intermediate for at-grade sections, and least for cut sections. This information will be useful for urban planning and for designing roadways. The combustion products of gasoline, including lead, bromine, chlorine, and sulfur, provided about 2/3 of all elements heavier than sodium observed in the particulate matter. About 80% of the elements heavier than sodium that were seen in particulates consisted of particles less than 1 micron in size. Combustion products dominated this class, with most mass occurring below 0.5 micron. Dispersion of particulates was dominated by wind conditions, with high values of particulate mass per vehicle mile occurring in calm periods in near freeway locations. (Author abstract modified)

72403

Nicholson, Sharon E.

A POLLUTION MODEL FOR STREET-LEVEL AIR. Atmos. Environ., 9(1):19-31, Jan. 1975. 16 refs.

A scalar budget-box diffusion model is developed to predict volume-average pollution concentrations in street canyons. Input is wind speed, direction, and total pollution emission at the lower boundary of the box. Vortex velocity is predicted by assuming logarithmic wind profiles above buildings and streets and by using the continuity equation. A bulk wind speed for winds parallel to the street is predicted by assuming an exponential wind profile in the canyon. Diurnal curves showing predicted and observed hourly values of carbon monoxide in Madison, Wisconsin; Chicago, Illinois; and Frankfurt, Germany are in reasonable agreement, indicating the usefulness of the model for vastly differing cities. (Author abstract modified)

72050

Jones, Herbert C.

PREOPERATIONAL ATMOSPHERIC MONITORING IN THE CUMBERLAND STEAM PLANT AREA: THE PH AND SULFATE CONTENT OF PRECIPITATION. Tennessee Valley Authority, Muscle Shoals, Ala., Air Pollution Effects Section, Rept. E-EB-74-1, 37p., Nov. 1974. 27 refs.

Rainfall samples collected around the Tennessee Valley Authority Cumberland Steam Plant before operation for the period September 1971 through July 1972 were analyzed for pH and sulfate. The rainfall in the area was much more acidic than geologically pure rainfall (pH 4.3 as compared with pH 5.7), though insufficient information exists to predict whether sulfur dioxide emissions from the steam plant are capable of further increasing rain acidity. The weighted average concentration of sulfates (3.4 mg/l) washed out in precipitation during the 11-month period before the steam plant began operating was about three times that considered to be background for areas remote from sources of sulfur emissions. The installation of five additional monitoring stations in the Cumberland Steam Plant air monitoring network to obtain more complete statistics on pH and sulfur content of precipitation is recommended along with the installation of precipitation collectors at regional air quality monitoring stations for observing long-term trends in precipitation acidity.

72065

Briggs, Gary A.

PRELIMINARY DRAFT. DIFFUSION ESTIMATION FOR SMALL EMISSIONS. In: Environmental Research Laboratories 1973 Annual Report. National Oceanic and Atmospheric Administration, Oak Ridge, Tenn., Atmospheric Turbulence and Diffusion Lab., Rept. ATDL-106, p. 83-145, Dec. 1974. 19 refs.

Procedures for the calculation of ground level concentrations of effluents from small industrial and fuel burning installations (source heights of less than 100 m) are discussed. Topics covered include: the calculation of effective plume height, assuming that it escapes the downwash effect of the stack and buildings; methods for predicting the occurrence of downwash; the estimation of building and buoyancy effects; the use of diffusion model coefficients and stability classes for estimating ground level concentrations from both elevated and ground sources; the computation of long term average concentrations; the extension of classical methods to the prediction of the long-term average deposition of particulates (30 days to 1 yr); the effects of mechanical and convective turbulence on plume diffusion in urban areas; and the effects of topographical interactions in diffusion.

71086

Schrecker, Gunter O., Karl R. Wilber, and Frederick M. Shofner

PREDICTION AND MEASUREMENT OF AIRBORNE PARTICULATE CONCENTRATIONS FROM COOLING DEVICES AND IN THE AMBIENT ATMOSPHERE. State of Maryland, Power Plant Siting Program and Atomic Energy Commission, Washington, D. C., Div. of Biomedical and Environmental Research, Cool. Tower Environ. Symp., College Park, Md., 1974, CONF-740302, p. 460-484, 1975. 9 refs. (March 4-6.)

The sensitivity of drift-particle mineral residue transport calculations to source and meteorological parameters is discussed for natural- and mechanical-draft cooling towers and spray module systems. The ground-level air salt concentration from either source contributions or ambient contributions is a more fundamental parameter for comparison than the deposition rate which is more difficult to measure or predict. Representative and accurate source data on particle density distribution and good meteorological data are required for the prediction of airborne mineral concentrations. Accurate source measurements for large particles are especially important for near-zone considerations; such measurements are critical for particles diameters greater than 100 micron with natural-draft towers, 50 micron with mechanical-draft towers, and diameters greater than 20 micron with spray systems. The accuracy requirements for far-zone considerations are less stringent since small particles are more influenced by atmospheric turbulence than by gravitational effects. Accurate information on the mass emissions associated with these particles is useful for comparison and prediction. Since far-zone source contributions are not appreciably reduced by even complete elimination of large particles, the increased costs and possibly reduced thermal efficiency associated with high-efficiency drift eliminator systems may be counter-productive. Airborne particle samplers can provide accurate sea-salt measurements at detection limits nearly two orders of magnitude lower than those of high-volume samplers. (Author conclusions modified)

71101

Stukel, J. J., R. L. Solomon, and J. L. Hudson

A MODEL FOR THE DISPERSION OF PARTICULATE OR GASEOUS POLLUTANTS FROM A NETWORK OF STREETS AND HIGHWAYS. Preprint, Illinois Univ., Urbana, Dept. of Chemical Engineering, 33p., 1975. 38 refs.

A computerized model for predicting the atmospheric transport of particulate and gaseous pollutants from finite length line sources representing a network of city streets and rural highways is described. The model can be used to predict the dispersion of pollutants in any region of flat terrain. The inputs required are the coordinates of the highway segments, traffic counts, and meteorological conditions. The model includes transport by advection, turbulent dispersion, and settling. A computer program is written to predict the distribution of pollutants from any combination of line segments which represent streets or highways. The model is applied to predicting the distribution of lead emitted from automobiles in the vicinity of Urbana-Champaign. (Author abstract modified)

71166

Mills, M. T., R. C. Dahlman, and J. S. Olson

GROUND-LEVEL AIR CONCENTRATIONS OF DUST PARTICLES DOWNWIND FROM A TAILINGS AREA DURING A TYPICAL WINDSTORM. Oak Ridge National Lab., Oak Ridge, Tenn., Computer Sciences Div., Atomic Energy Commission Contract W-7405-eng-26, Rept. ORNL-TM-4375, 44p., Sept. 1974. 18 refs.

An atmospheric transport model for predicting the wind-induced suspension of toxic particulates deposited on a ground surface is described. The threshold wind speed for the onset of saltation (the rolling and bouncing of individual grains across the surface) is found by setting the moment about the sand grain pivot point due to the particle weight equal to the moment due to the drag force. The ground-level air concentration of dust downwind from a tailings site can be calculated by using a Gaussian plume equation with a modification to account for plume depletion due to dry deposition. Application of the model to the wind-induced suspension of a uranium mill tailings pile results in estimated values that are within a factor of 2-15 of those observed. The results obtained at three stations are not inconsistent with the model predictions, considering the fact that the saltation ratio may easily vary by an order of magnitude from one site to another.

77087
Edwards, H. W., R. J. Rosenvold, and H. G. Wheat
LEAD ALKYL - PARTICULATE INTERACTIONS. In: Environmental Contamination Caused by Lead (Interim Report). Colorado State Univ., Fort Collins, National Science Foundation Grants GI-34813X and GI-44423, p. 313-333, Dec. 31, 1974. 15 refs.

The exposure of simulated atmospheric dust components to air streams doped with tetraethyl lead, both in the presence of water vapor, resulted in the uptake of lead by the solids. Lead uptake on a specific surface area basis was greatest for graphitized carbon black substrate, followed by carbon black, aluminum oxide, and silicon dioxide. Sorbed lead was only very slowly removed upon aging. A major effect of aging exposed samples was the conversion of a substantial portion of the sorbed lead compounds into species that were not removed with normal-hexane extraction or moderate heating. Sorption of organic lead compounds on atmospheric dust components thus appears to represent a significant scavenging mechanism, and atmospheric particulates appear to serve as substrates for the conversion of sorbed organic lead to inorganic lead compounds. (Author abstract modified)

77132
Augustine, Frank E. and Richard W. Boubel
PARTICLE SIZE DISTRIBUTIONS OF KRAFT PAPER MILL AEROSOLS OBTAINED BY AIRBORNE SAMPLING. J. Air Pollution Control Assoc., 25(6):617-621, June 1975. 8 refs.

Size distributions of particles at several downwind points in a Kraft paper mill plume were determined by means of airborne sampling. Nuclepore filters were used as the primary sampling filters. Size distributions from samples close to the stack have a log normal frequency distribution, but significant deviations from the log normal were found farther downwind. Several possible physical mechanisms are postulated as causes for this behavior, including breakup of agglomerated particles after exit from the stack, loss of water from particle droplets due to evaporation, dilution of the plume with particles of a smaller average size, and downwind agglomeration of particles. Plume dilution with background particles appears to be the most likely mechanism. (Author abstract modified)

77140
Liu, Mei-Kao and John H. Seinfeld
ON THE VALIDITY OF GRID AND TRAJECTORY MODELS OF URBAN AIR POLLUTION. Atmos. Environ., 9(6/7):555-574, June/July 1975. 18 refs.

The validity of grid and trajectory models of urban air pollution was evaluated and the magnitude of errors in the solution of the diffusion equation was determined. Grid models imply a coordinate system fixed with respect to the ground, whereas trajectory models have a coordinate system centered on a fictitious vertical air column which moves horizontally with the advective wind. Both models are based on the atmospheric diffusion equation as the essential description of turbulent advection and diffusion. The primary errors committed in the grid model are those attributed to finite difference approximations, whereas the errors in the trajectory model are mainly a result of the assumptions inherent in the model formulation, such as neglect of horizontal turbulent diffusion across the parcel boundaries and neglect of wind shear. Quantitative conditions based on comparison of exact solutions of the atmospheric diffusion equation with those of the grid and trajectory models are derived to indicate when these two classes of models may be accurately employed for various regimes of stability, wind shear, and source configuration.

77830
Schere, Kenneth L. and Dennis W. Thomson
VERTICAL PROFILES AND SIZE DISTRIBUTIONS OF PARTICULATES OVER ST. LOUIS, MISSOURI. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1975. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-58.5.)

Vertical profiles and size distributions of the aerosol burden upwind, over, and downwind of the St. Louis metropolitan area were studied concurrently with the 1973-1974 Regional Air Pollution Study. A marked homogeneity is evident in particulate number density within the mixed layer, especially during afternoon hours. Although this feature is present in air masses of differing origin, the magnitude of the particulate number concentration is observed to differ by more than an order of magnitude from one air mass to another. Many individual profiles exhibit the masking influence of nearby anthropogenic sources on the normal dispersion patterns. Airborne estimates of the size distributions of the aerosols are also obtained. The effects of the changing proportions of large and small particles on the size spectra affect the shape of the size distribution. Representative size distributions are presented in graphic form for each of two distinct air masses and altitudes. (Author abstract modified)

77886
Sehmel, George A.
EXPERIMENTAL MEASUREMENTS AND PREDICTIONS OF PARTICLE DEPOSITION AND RESUSPENSION RATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1975. 18 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-32.5.)

Results from experiments investigating particle deposition and resuspension rates are reported. Deposition studies were conducted with a wind tunnel in which monodisperse aerosols were allowed to deposit on a variety of surfaces. Various wind speeds were employed, and data obtained for the deposition velocities were correlated with particle size, surface roughness, and wind speed. Deposition velocities varied over several orders of magnitude from 0.001 to 10 cm/sec. The actual value was dependent on particle diameter, particle density, surface roughness, and wind speed and reflected the relative contribution to mass transfer of Brownian diffusion, eddy diffusion, and gravity settling. Deposition velocities were also a function of atmospheric stability, but the dependence was relatively minor. Deposition velocities in all cases were greater than those predicted by simple gravity settling rates. Experiments in which submicron preformed aerosol was seeded onto a plot of ground revealed resuspension rates ranging from 1 times 10 to the -10 fraction resuspended per second for 1.3 m/sec winds to 4 times 10 to the -8 fraction per second for 5.8 m/sec winds. (Author abstract modified)

78078
Chu, Kuang J. and John H. Seinfeld
FORMULATION AND INITIAL APPLICATION OF A DYNAMIC MODEL FOR URBAN AEROSOLS. Atmos. Environ., 9(4):[illegible]-402, April 1975, 38 refs.

A dynamic model for prediction of the spatial and temporal behavior of the size and chemical composition distributions of an urban air pollution aerosol is developed. Particular attention is given to the description of aerosol formation and growth in photochemical smog, in which the aerosol of interest lies primarily in the size range 0.1-1 micron diameter. The dynamic model developed is used to simulate aerosol number and mass concentrations and size distributions along several typical air trajectories on Sept. 30, 1973 in the Los Angeles basin. Predictions of the model are compared with a total aerosol mass concentrations computed from light scattering measurements. The sensitivity of the predictions to assumptions concerning the nature of gas to particle conversion processes is explored. (Author abstract)

78181
McCollister, George M. and Keith R. Wilson
LINEAR STOCHASTIC MODELS FOR FORECASTING DAILY MAXIMA AND HOURLY CONCENTRATIONS OF AIR POLLUTANTS. Atmos. Environ., 9(4):417-423, April 1975, 18 refs.

Two related time series models were developed to forecast concentrations of various air pollutants and tested on carbon monoxide and oxidant data for the Los Angeles basin. One model forecasts daily maximum concentrations of a particular pollutant using only past daily maximum values of that pollutant as input. The other model forecasts 1 hr average concentrations using only the past hourly average values. Both are significantly more accurate than persistence, i.e., forecasting for tomorrow what occurred today (or yesterday). Model forecasts for 1972 of the daily instantaneous maxima for total oxidant made using only past pollutant concentration data are more accurate than those made by the Los Angeles APCD using meteorological input as well as pollutant concentrations. Although none of these models forecast as accurately as might be desired for a health warning system, the relative success of simple time series models, even though based solely on pollutant concentration, suggests that models incorporating meteorological data and using either multi-dimensional time series or pattern recognition techniques should be tested. (Author abstract modified)

84730
Ragland, K. W.
WORST-CASE AMBIENT AIR CONCENTRATIONS FROM POINT SOURCES USING THE GAUSSIAN PLUME MODEL. Atmos. Environ., vol. 10:371-374, 1976, 10 refs.

The highest possible ground-level ambient air concentrations due to an elevated point source diffusing over flat terrain were obtained from the Gaussian Plume Model for power law forms of the dispersion coefficients. The critical wind speed, critical plume height and distance downwind were also obtained. The results are discussed for various sets of Gaussian dispersion coefficients and the increased concentrations due to trapping are presented. (Author abstract)

84731
Sharma, V. and L. O. Myrup
DIFFUSION FROM A LINE SOURCE IN AN URBAN ATMOSPHERE. Atmos. Environ., vol. 9:907-922, 1975, 18 refs.

A model for the diffusion of material from a line source in an urban atmosphere is presented. The plume is assumed to have a well-defined edge at which the concentration falls to zero. The vertical wind shear is accounted for by using a power law, the exponent of which is explicitly determinable as a function of surface roughness characteristics of the terrain and the stability of the atmosphere (Monin-Obukhov length, L). The concentrations estimated from the model compare favorably with the field observations of other investigators. (Author abstract)

84740
Chock, David P.
THE GENERAL MOTORS SULFATE DISPERSION EXPERIMENT: ASSESSMENT OF THE EPA HIWAY MODEL. Preprint, Environmental Protection Agency, Washington, D.C., 33p., 1976. (Presented at the GM Sulfate Dispersion Experiment Symposium, Research Triangle Park, N.C., April 12, 1976, Paper GMR-2126 EV-37.)

A major objective of the General Motors Sulfate Dispersion Experiment was to investigate the validity of the Environmental Protection Agency's HIWAY dispersion model. This model was the basis for the high roadside predictions made by EPA in 1975. Comparison of measurements with predictions show that under the worst meteorological conditions, variable winds at different heights and plume rise due to the heated exhaust completely invalidate the model. Under other adverse meteorological conditions, the model also grossly overpredicts sulfate concentrations near the ground. Overpredictions by as high as a factor of 10 were observed for the roadside position. The overpredictions worsen as the distance from the roadway increases. When the wind is parallel to the road, substantial overpredictions occur at all sampling positions. New dispersion parameters were determined which substantiate the expectation that mechanical mixing due to the traffic wake completely dominates the effects of atmospheric stability. It is expected that the overprediction of the HIWAY model at ground level will become worse as the number of traffic lanes increases. In fact, the values of the dispersion parameters are expected to increase with the number of lanes since the material from the upwind lane will experience a longer interval of turbulent mixing before leaving the roadway. (Author abstract)

84738
Petersen, William B.
COMPARISON OF DISPERSION MODEL ESTIMATES WITH MEASURED SULFATE CONCENTRATIONS. Environmental Protection Agency, EPA-600/3-76-035, 9p, 7 refs. In: The General Motors/Environmental Protection Agency Sulfate Dispersion Experiment: Selected EPA Research Program, April 1976.

A fleet of about 400 catalyst equipped vehicles were operated on the test track at GM's Milford Proving Ground. This type of controlled equipment provides an excellent opportunity to compare estimates from the EPA HIWAY Model with measured sulfate concentrations. Concentration estimates from HIWAY are compared with sampling measurements observed for several weeks during morning hours. Performance of the model at the receptor heights and at several distances downwind from the test track is also investigated. The HIWAY model gave concentration estimates best in cases when the winds were near perpendicular to the track.

overestimated concentrations when the winds were near parallel. During unstable atmospheric conditions, HIWAY estimated concentrations well. For stable conditions, HIWAY overestimated concentrations. (Author abstract)

04761

Wilson, William E., Robert J. Charlson, Rudolf B. Husar, Kenneth T. Whitby, and Donald Blumenthal

SULFATES IN THE ATMOSPHERE. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1976. 31 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-30.06.)

A transformation-transport theory is advanced to explain the failure of an observed reduction in urban sulfur dioxide emissions and concentrations (due to mandatory use low-sulfur fuels) to be accompanied by a proportional decrease in urban sulfate. Reductions in urban SO_2 emissions have been accompanied by increases in rural SO_2 emissions from new power plants located outside cities. SO_2 from these power plants may be transformed to sulfate in the atmosphere and transported over long distances to urban areas. Earlier work had shown that the rate of conversion of SO_2 to sulfate in power plant plumes was slow (1 percent/hr) except at very high relative humidity. In the recent EPA program, consistent conversion of several percent per hour at normal levels of relative humidity has been measured. The conversion of SO_2 to sulfate occurred in power plant plumes is slow in the early part of the plume; that is, close to the point of emission. As ambient air mixes with the plume, the rate of conversion increases. Thus tall stacks reduce the ground-level concentrations of SO_2 but increase sulfate aerosol formation by reducing surface losses of SO_2 and by increasing the atmospheric residence time, which results in increased SO_2-to-sulfate conversion. In urban plumes, which are well-mixed to the ground, SO_2 may be removed by reaction with plants and by deposition. The SO_2 dry deposition rates vary with vegetation, with the nature of the surface, and with time of year. Urban plumes have been sampled out to 150 km from their sources and power plant plumes out to 60 km. Sampling at these distances revealed that sulfate, generated from SO_2 in power plant and urban plumes, and ozone, generated from hydrocarbons and nitrogen oxides in urban plumes, may be transported at least hundreds of km and may cause air pollution episodes and other problems far from the source of pollution. These air pollution problems cannot be controlled by the governmental entity where the air pollution impact actually occurs. (Author abstract)

04767

Cole, Clifford F. and Bruce E. Hanna

MODELING PARTICULATE CONCENTRATIONS AND DUSTFALL RATES AT WHITE ROCKS SAND AND GRAVEL MINE. Preprint, The Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1976. 6 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-8.5.)

The ability of two predictive dispersion-deposition models to simulate particulate concentrations and dustfall rates at a sand and gravel mine has been demonstrated. Using basic input data (material throughput and storage mass, wind speed and wind direction frequencies of occurrence and particle size distributions) that would be available at most sites before mining activity began, accurate predictions of suspended particulate concentrations in the vicinity of the mine can be made. A modification in one of the models to allow for re-entrainment of particulate downwind of the source significantly improves the agreement between measured and predicted values could have been further improved at the White Rocks site by model tuning. It should not be assumed that the same simple models could produce equally accurate predictions at any surface mine. Certain factors such as topography, ground surface characteristics and geographic distribution of the source have a pronounced influence on dispersion and deposition, and if not correctly taken into account will result in poor simulations. On the other hand, there is no reason to believe that predictions as accurate as those at the White Rocks could not be made at mine sites similar to White Rocks. The modification made to Model 1, which analytically prevents the plume centerline from penetrating the ground, clearly improves the prediction of dustfall rates. Furthermore, the suspected physical mechanism which prompts the modification, re-entrainment of particulate at ground level, seems plausible. Yet before this explanation can be accepted with confidence additional evidence of re-entrainment, possibly by direct measurement of dustfall rates upwind and downwind of a section of hard-packed ground in the vicinity of the mine, should be sought. (Author abstract)

04772

Rao, K. S., I. Thomson, and B. A. Egan

REGIONAL TRANSPORT MODEL OF ATMOSPHERIC SULFATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1976. 8 refs. (Presented at the Air Pollution Control Association Annual Meeting, 69th, Portland, Oreg., June 27-July 1, 1976, Paper 76-58.3.)

In recent years, there has been substantial evidence that particulate sulfate in the presence of sulfur oxide gases is a major contributor to the health hazards of air pollution, and there is considerable interest in developing a strategy for controlling the atmospheric sulfate concentration levels. This requires a systematic modeling program supported by observations aimed at understanding the relation between the emissions, chemical transformation, deposition, transport, and dispersion of sulfur oxides over distances of hundreds of kilometers from major sources. As part of the Sulfate Regional Experiment (SURE) Design Project, a regional transport model of atmospheric sulfates has been developed. This quasi-Lagrangian, three-dimensional grid numerical model uses a detailed SO_2 emission inventory of major anthropogenic sources in the eastern U. S. region, and observed meteorological data during an episode as inputs. The model accounts for advective transport and turbulent diffusion of the pollutants. The chemical transformation of SO_2 and sulfate and the deposition of the species at the earth's surface are assumed to be linear processes at specified constant rates. The numerical model can predict the daily average concentrations of SO_2 and SO_4 at all receptor locations in the grid region during the episode. Because of the spatial resolution of the grid, this model is particularly suited to investigate the effect of tall stacks in reducing the ambient concentration levels of sulfur pollutants. This paper presents the formulations and assumptions of the regional sulfate transport model. The model inputs and results are discussed. Isopleths of predicted SO_2 and SO_4 concentrations are compared with the observed ground level values. The bulk of the information in this paper is directed to air pollution meteorologists and environmental engineers interested in the atmospheric transport modeling studies of sulfur oxide pollutants. (Author abstract)

F. BASIC SCIENCE AND TECHNOLOGY

08474

Kirsch, A. A., I. B. Stechkina, and N. A. Fuchs

GAS FLOW IN AEROSOL FILTERS MADE OF POLYDISPERSE ULTRAFINE FIBERS. J. Aerosol Sci., 5(1):39-45, Jan. 1974. 9 refs.

The most efficient modern aerosol filters are made of ultrafine polydisperse glass fibers. Gas flow and pressure drop in these filters were measured at various pressures from 760 to 4 torr. A semiempirical formula was proposed and verified experimentally for the pressure drop as a function of the Knudsen number, packing density, and degree of structure nonuniformity of the filters. The polydispersity of fibers in a filter does not disturb the linear dependence of the pressure drop across a filter on the Knudsen number, in spite of the fact that the gas flow at the surface of thick and thin fibers is of a quite different character. Thus, the polydisperse filters can be described by a formula with the dependence of drag calculated by another formula and tau equals 1.4. (Author abstract modified)

10080

Shlien, D. J. and S. Corrsin

A MEASUREMENT OF LAGRANGIAN VELOCITY AUTOCORRELATION IN APPROXIMATELY ISOTROPIC TURBULENCE. J. Fluid Mech. (Cambridge), 62(2):255-271, 1974. 31 refs.

Atmospheric turbulence disperses solid and fluid particles and measurement of this phenomenon is basic to heat and mass transport problems. Heated particles can be used to calculate the Lagrangian velocity correlation from particle dispersion. The mean temperature profile behind a heating wire spanning an isotropic turbulence input simulates the probability density of the lateral displacement of a fluid particle. It is Gaussian within the accuracy of measurement, supporting earlier results. The maximum scatter on a typical profile is less than 3% of the peak. The measured Lagrangian velocity microscale of time is much larger than the Eulerian microscale of the turbulent velocity observed in a frame moving with the mean flow. The stationary Lagrangian time integral scale is about 30% larger than that of the Eulerian correlation moving with the mean flow. The Lagrangian velocity correlation coefficient was calculated and compared with the simplest Eulerian velocity correlation in time, i.e., that moving with the mean flow. They are rather different in shape. A realistic assumption of self-preservation of the particle velocities are made to calculate the Lagrangian correlation coefficient. This assumption collapsed the data taken with the source at two different stages of decay, verifying the self-preservation assumption. The recasting of the results into those for a hypothetical stationary decaying isotropic turbulence should be useful for comparison with future theories; theories tend to be simpler for nondecaying isotropic turbulence. (Author conclusions modified)

08150

Liu, Benjamin Y. H. and Timothy A. Ilori

AEROSOL DEPOSITION IN TURBULENT PIPE FLOW. Environ. Sci. Technol., 8(4):351-356, April 1974. 48 refs.

A model is proposed for calculating the effective particle diffusivity, epsilon p, in the boundary layer of a turbulent fluid. It is based on the analogy between the diffusion of particles caused by Brownian motion and that caused by fluid turbulence. The model results in epsilon p being equal to epsilon plus v squared times tau, where epsilon is the eddy diffusivity, v is the root-mean-square fluctuating velocity of the fluid in a direction normal to the wall, and tau is the particle relaxation time. Results are presented demonstrating that the particle deposition rate based on this effective particle diffusivity and diffusion free flight model is in general agreement with experimental data without the need to use either unreasonably high or arbitrary free-flight velocities as in previous theories in which particle and eddy momentum diffusivities are assumed equal. (Author abstract modified)

11787

Scott, David S. and Donald F. Rennick

ON THE DYNAMICS OF SMALL AEROSOL PARTICLES. J. Aerosol Sci., 5(4):303-319, 1974. 13 refs.

Matters related to the difference between the typical trajectory of an individual Knudsen particle and the mean trajectory of a cloud of such particles are introduced. To illustrate these matters, a statistical numerical procedure which yields individual particle trajectories is presented. The success of the procedure in a relatively straightforward physical circumstance suggests that its extension to the modeling of more complex situations is plausible. The proper interpretation and limitations of recent free molecular and transition theories as they apply to small aerosol particles are discussed. Examples from the literature are used to illustrate the arguments presented. Particle random thermal motion is important to the dynamics of Knudsen particle aerosols, and its relation to transition and free molecular mean force theories must be appreciated when applying such theories. (Author abstract modified)

04811

Grams, G. W., I. H. Blifford, Jr., D. A. Gillette, and P. B. Russell

COMPLEX INDEX OF REFRACTION OF AIRBORNE SOIL PARTICLES. J. Appl. Meteorol., 13(4):459-471, June 1974. 23 refs.

The angular variation of the intensity of light scattered from a collimated beam by airborne soil particles and the size distribution of the particles were measured simultaneously 1.5 m above the ground. The measurements gave an estimate of the complex index of refraction of airborne soil particles equal to the real part minus the imaginary part of the refractive index. Standard microscopic analysis procedures were employed to determine the real part of the refractive index. Although a wide range of values was observed, the value of 1.525 was taken as representative. By applying Mie scattering theory to each of the observed distributions of particle size, the expected angular variation of the intensity of the scattered light was calculated for a fixed value of the real part of the refractive index and a wide range of values of imaginary refractive index. For each set of simultaneous measurements, the value of the imaginary part of the refractive index was that value which provided the best fit to the experimental data. The upper limit of the value of the imaginary part of the refractive index for the airborne particles studied was 0.005 with an uncertainty factor of about two. The estimate of the imaginary part was fairly insensitive to the assumed value of the real part of the refractive index. (Author abstract modified)

65567

Novakov, T.

SULFATES IN POLLUTION PARTICULATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 31p., 1974. 12 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-[illegible].)

Experimental evidence is presented which demonstrates that combustion-generated carbon particles in the form of finely divided soot are efficient catalysts involved in sulfur dioxide oxidation to sulfates. Both soot and graphite particles in the air catalytically oxidize SO2, with soot-catalyzed oxidation playing a major role even in the presence of combustion-produced gases. The sulfate species produced on carbon particles are unstable in vacuum but are water soluble and when dissolved increase the acidity of the solution. Field study results are compatible with this oxidation mechanism. (Author abstract modified)

65573

Jaffe, Raphael J. and Frank C. Smith, Jr.

FACTORS AFFECTING REACTIONS IN SMOG CHAMBERS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 38p., 1974. 7 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-[illegible].)

Results of a study of a smog chamber illuminated by a xenon arc lamp are presented along with a study of the differences between smog chambers, including an experimental study of how various design and operational variables affect the photochemical reactions observed in smog chambers. A group of round-robin tests were conducted using these chambers as follows: irradiation of seven different hydrocarbons with nitrogen oxides; replicate runs to establish reproducibility using the propylene-nitrogen oxides system; a reactant concentration study in which 3 ppm propylene was reacted with 1, 1.5 and 0.5 ppm nitrogen oxides. Apparatus used was specifically designed to meet the objectives of the study by allowing independent variation in materials, configuration, lighting conditions, and cleaning technique. The illuminator produces a collimated light beam. Plates of materials can be placed parallel to the beam axis without affecting the light conditions. This decoupling of light and materials allows independent variation of the two factors. Major apparatus items are the smog chamber, the xenon arc lamp illuminator, the thermal enclosure for the chamber, and the gas analysis instrumentation. The spectral distribution of light provided a smog chamber influencing the photochemical reaction observed. In particular, the nitrogen dioxide photodisintegration rate (k sub d or its equivalent k sub 1) does not sufficiently characterize the light conditions. Further data analysis and experimentation is required to understand the spectral sensitivity phenomena demonstrated in this work. The understanding of the hydrocarbon-oxides of nitrogen-sunlight systems, particularly in regard to the conversion of nitric oxide to NO2, is not complete

66648

Henley, David C.

AN ANALYSIS OF RANDOM FLUCTUATIONS IN ATMOSPHERIC DUST CONCENTRATIONS. Army Electronics Command, White Sands Missile Range, N. Mex., Atmospheric Sciences Lab., Task 1T161102B53A-19, Rept. ECOM-5520, 30p., Jan. 1974. 4 refs. NTIS, DDC: AD 774854

A modified structure function analysis is developed for and applied to time series data on the number concentration of atmospheric dust particles. Preliminary indications are that this application is a useful method of analysis for particle concentration fluctuations, though the data should be submitted to the whole spectrum of time series analysis in the interest of completeness. (Author summary modified)

66651

Kim, Yong W.

AN ANALYTICAL CONSIDERATION OF THE PARTICLE INERTIA EFFECT WITH AN APPLICATION TO AEROSOL SAMPLING EFFICIENCY CALCULATION. Lehigh Univ., Bethlehem, Pa., Dept. of Physics, Bureau of Mines Grant G0133035, TR 24, 89p., Jan. 1974. 13 refs. NTIS: PB-[illegible]

The particle inertia effect, in the absence of all other competing effects, is treated analytically with parallel laboratory experiments for application to the calculation of aerosol sampling efficiency. Expressions for two universal coefficients are obtained which give rise to quantitative measures of the inertia effect for a variety of given flow fields. A two-dimensional sampler is used for studying the particle sampling efficiency in the presence of the pure inertia effect, and descriptions for the model system are established by first measuring the field with tracer particles and then comparing the measurement with existing theoretical results. A general scheme of computing the number of sampled particles for each specific size category is established and applied to the model system, with the results showing that the sampled particle number density exceeds the free stream density as a result of readjustment of the particle number density in the sampler inlet region due to the inertia effect. The sampling efficiency increases with particle size for the particles ranging from 1-10 micron in diameter. The prediction is confirmed by measurements of the particle size distribution before and after sampling, and a method is devised for particle size determination. (Author abstract modified)

66697

Novakov, T., S. G. Chang, and A. B. Harker

SULFATES AS POLLUTION PARTICULATES: CATALYTIC FORMATION ON CARBON (SOOT) PARTICLES. Science, 186(4160):259-261, Oct. 18, 1974. 13 refs.

Experimental evidence (obtained by electron spectroscopy for chemical analysis) is presented which shows that finely divided carbon (soot) particles may play a major role in the catalytic oxidation of sulfur dioxide to sulfate in polluted atmospheres. The results obtained with sulfates produced in the laboratory by the oxidation of sulfur dioxide on graphite particles and combustion-produced soot particles are compared with the properties and behavior of ambient sulfates. The proposed SO2 oxidation mechanism is qualitatively consistent with field observations. The catalytic formation of sulfate on soot is expected to occur in the open atmosphere and especially in or near combustion sources where both SO2 and soot concentrations are highest. Although the sulfate formation mechanism described may not be the only atmospheric sulfate-producing process, it probably plays a major role in urban atmospheres characterized by high concentrations of particulate carbon. (Author abstract modified)

69438

Cha, C. Y. and B. J. McCoy

THERMAL FORCE ON AEROSOL PARTICLES. Phys. Fluids, 17(7):1376-1380, July 1974. 21 refs.

With a method previously applied to thermal transpiration and planar radiometric force, the force on a spherical aerosol particle in a gas which sustains a temperature gradient is analyzed theoretically. Expressions for thermal force and thermal velocity span all values of the particle Knudsen number and show the effect of imperfect accommodation. The model consists of a spherical particle suspended in a gas midway between two plane surfaces at different temperatures. The theory of thermophoresis (thermal force) is an adaptation of the analysis used for the planar thermal (radiometric force). The linearized Burnett second-order constitutive equations for heat flux and stress applied to the gas between the plane surfaces and provide the coupling between temperature gradients and momentum flux. Expressions for transition regime viscosity and thermal conductivity coefficients are used for the particular geometry of the problem. These transport coefficients allow the theory to span the transition regime. A differential equation for the gas temperature distribution is derived and solved with the aid of boundary and heat conditions. The temperature-induced stress provides a force on the spherical aerosol particle. When the thermal force is balanced by a drag force, an expression for the velocity of thermophoresis is obtained. The theoretical thermal force and thermophoresis velocity are compared with experimental data and with previous theories.

70407

Hedley, W. H., S. M. Mehta, C. M. Moscowitz, A. D. Snyder, H. H. S. Yu, and D. L. Zanders

SOURCES AND CHARACTERIZATION OF FINE PARTICULATE TEST DUSTS (FINAL REPORT). Monsanto Research Corp., Dayton, Ohio, Environmental Protection Agency Contract 68-02-1306, Task 3, Program Element 1AB012, EPA-650/2-74-117, ROAP 21ADM-021, MRC-DA-431, 107p., Nov. 1974. 47 refs. NTIS: PB 238 922/AS

Suitable characterization criteria for test dusts were developed to determine procedures for obtaining, handling, and characterizing the dusts and to establish potential suppliers of test dusts. Seventeen criteria were identified: size distribution; shape; surface area, and pore volume; chemical composition; density; wettability and moisture content; solubility; hardness, abrasiveness, and grindability; charge properties; dielectric properties; corrosiveness; optical properties; magnetic susceptibility; carrier gas composition; and solids loading. Potential industrial suppliers of test dusts for simulation purposes were identified for 11 industries: pulverized coal combustion, stoker-fired coal combustion, basic oxygen furnaces, open hearth furnaces, electric arc furnaces, metallurgical coke ovens, cement plants, municipal incinerators, steel foundries, Kraft pulp mill recovery furnaces, and asphalt plants. The production of a particulate-laden test flue gas was evaluated. Redispersion of collected dusts is favored over generation of fresh particulate. (Author abstract modified)

70711

Sinclair, David, Richard J. Countess, and George S. Hoopes

EFFECT OF RELATIVE HUMIDITY ON THE SIZE OF ATMOSPHERIC AEROSOL PARTICLES. Atmos. Environ., 8(11):1111-1117, Nov. 1974. 16 refs.

In situ measurements of the growth of atmospheric aerosol particles (about one-tenth the size of particles which dominate atmospheric light scattering) with increasing relative humidity (0-98%) were made with miniature diffusion batteries and a continuous flow condensation nuclei counter. Particle size distributions computed from the battery measurements were log normal. The number median diameter increased twofold from 0.019 to 0.038 micron over the range of humidity investigated. The range of geometric standard deviation for the particle size distributions was 1.72-2.06, with the larger number median diameter having the smaller geometric standard deviation. This indicates that the smaller particles grow proportionately more than the larger and that the total respiratory deposition of small hygroscopic material will decrease during periods of high humidity. (Author abstract modified)

72304

Bickelhaupt, Roy E.

SURFACE RESISTIVITY AND THE CHEMICAL COMPOSITION OF FLY ASH. J. Air Pollution Control Assoc., 25(2):148-152, Feb. 1975. 10 refs.

The relationship between surface resistivity and the chemical composition of fly ash was determined. Resistivity was determined for a group of well characterized ashes representing both eastern and western coals. Data were taken between 60 and 230 C in an environment of air containing approximately 9 vol% water. Chemical transference experiments were conducted for two ashes having substantially different chemical compositions. Chemical analyses of the transference specimens revealed a pronounced migration of alkali metal ions toward the negative electrode. The surface resistivity was inversely proportional to the concentration of these ions. The iron concentration influenced particularly the participation of potassium. Surface resistivity is sensitive to the chemical composition of fly ash because the alkali metals serve as charge carriers. The conduction mechanism is probably analogous to that of glass. (Author abstract modified)

72867

Davis, James A., Susan M. Davenport, and Frank Biggs

ON ESTIMATION OF PARTICLE SIZE DISTRIBUTIONS. Sandia Lab., Albuquerque, N. Mex., Atomic Energy Commission Contract, 26p., Feb. 1974. 9 refs. NTIS: SLA-73-0879

A numerical means for estimating the distribution of particle sizes in the atmosphere is presented. The method assumes that a linear probe, to which the particles are opaque, is to scan a subset of a plane within the volume containing the particles. When the probe intersects a particle, it is interrupted for a time proportional to the maximum width of the cross section intersected in the direction of the motion of the probe. Under certain assumptions, the distribution of cross section diameters is written as an integral equation involving the underlying size distribution. The measurement data are used to estimate the distribution of cross sections, and the integral equation is then numerically unfolded to yield an estimate of the particle size distribution. Monte Carlo simulations of the physical experiment are performed for several distributions to demonstrate the numerical technique. (Author abstract modified)

73061

Broida, H. P., Jay D. Eversole, and Paul R. Hammes

STUDIES OF SMALL METALLIC PARTICLES FORMED BY HOMOGENEOUS NUCLEATION: LIGHT SCATTERING AND ELECTRON MICROSCOPY (FINAL REPORT). California Univ., Santa Barbara, Dept. of Physics, Environmental Protection Agency Grant R-800881, Proj. 21AJN-004, Program Element 1AA008, Rept. EPA-650/2-75-008, 45p., Feb. 1975. 34 refs. NTIS: PB 240 083/AS

The formation of metallic particles ranging from 1-5000 nm in diameter by homogeneous nucleation from the vapor phase was studied using light scattering and electron microscopy. Metals used in the experiments included: sodium, potassium, lithium, rubidium, cesium, cadmium, magnesium, zinc, and lead. Plasma resonance peaks and widths for alkali metal particles were observed to change systematically with system parameters. The growth of Zn particles was observed with electron microscopy which revealed characteristic geometric shapes. The correlation of these observations may provide information necessary to compute nucleation and growth rates in a steady-state system. (Author abstract modified)

[illegible]

Bickelhaupt, R. E.

EFFECT OF CHEMICAL COMPOSITION ON SURFACE RESISTIVITY OF FLY ASH (FINAL REPORT). Southern Research Inst., Birmingham, Ala., Environmental Protection Agency Contract 68-02-1303, Program Element 1AB012, ROAP 21ADJ-026, Rept. EPA-600/2-75-017, SORI-EAS-75-307, 3130-XV, [illegible]p., Aug. 1975. [illegible] refs. (NTIS: PB [illegible])

Resistivity was determined for a group of well characterized fly ashes representing both Eastern and Western coals. Data were obtained between 80 and 190 C in an air environment containing approximately 9 vol% water. Chemical transference experiments were conducted for two ashes having substantially different chemical compositions and revealed a pronounced migration of alkali metal ions toward the negative electrode. The surface resistivity was inversely proportional to the concentration of these ions which in turn was especially influenced by the participation of potassium in the current conduction process. The sensitivity of surface resistivity to the chemical composition of fly ash was apparently due to the alkali metals serving as charge carriers, with the conduction mechanism being probably analogous to that of glass. (Author abstract modified)

[illegible]

[illegible], Myron L.

NUCLEATION AS A COMPETITIVE FACTOR IN GAS-TO-PARTICLE CONVERSION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 8p., 1975. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-43.1.)

The pathways by which emitted gases are converted to particulate matter are considered. Homogeneous nucleation and physical or chemical adsorption are discarded as insignificant. Other factors considered include heterogeneous nucleation, heterogeneous catalysis, heteromolecular nucleation, and solubility. These are at present too poorly understood to permit evaluation of their relative importance. It is quite likely that many processes occur simultaneously and that the products of one such process are the raw material of another. (Author abstract modified)

[illegible]

Lioy, Paul J., George T. Wolff, and Raymond M. [illegible]

AEROSOL [illegible] RESEARCH AT RUTGERS UNIVERSITY: 1. BEHAVIOR OF SOLUBLE PARTICLES, AND 2. SURFACE INTERACTION OF GASES ON SOLID PARTICLES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1975. 7 refs. (Presented at the Air Pollution Control Association Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-33.6.)

Aerosol research in two aspects of submicron particle behavior in environmental systems is described. The growth of submicron particle aerosol generated from pure sodium chloride solutions and brackish water, collected at the inlet to a cooling tower was studied at a carrier air temperature of 18 ± 1 C and at specific relative humidities between 80-90%. The heterogeneous nature of the brackish water aerosol tends to limit growth and ultimate droplet size, when compared to that obtained for the saline droplet aerosol. The system of the heterogeneous surface interactions of sulfur dioxide and metal oxide aerosols was studied. Chemisorption of SO2 is strongly influenced by relative humidity. Two regimes of chemisorption are discerned: from 0-80% relative humidity, and from 80% to less than 100%. When submicron oxide contains less than a monolayer of SO2, the amount of sulfate formed is directly proportional to the amount of sorbed SO2. Large particles are effective in oxidizing SO2 because they contain more adsorbed water. (Author abstract modified)

[illegible]

Blanchard, Duncan C.

INTERNATIONAL SYMPOSIUM ON THE CHEMISTRY OF SEA/AIR PARTICULATE EXCHANGE PROCESSES: SUMMARY AND RECOMMENDATIONS. J. Rech. Atmospheriques, [illegible], July-Dec. 1974. 19 refs. (Presented at the International Symposium on the Chemistry of Sea/Air Particulate Exchange Processes, Nice, France, Oct. 8-10, 1973.)

Sources of marine particles and marine particulate exchange processes are discussed. Topics covered include the composition of sea surface microlayers, the importance of dissolved organic material in the sea, secondary particle production and enrichment in the phase change, insoluble dust, and particle residence time. Most particulate material in the marine atmosphere far removed from the continents is not produced by the sea. Even in remote regions of the oceans, especially over the tropical Atlantic, the dust loading of the atmosphere exceeds that of the ocean derived material. These dusts, originating from the desert regions of the world, make it difficult to understand and interpret aerosol chemistry. Continued pollution of the oceans and fresh water bodies of the earth produces profound changes in these surfaces and in the chemistry and biology of the water to air transfer of particulate material. Increased pollution of the water brings about a pollution of the atmosphere.

[illegible]

Fraser, Donald I.

IDENTIFICATION AND MEASUREMENT OF PARTICULATE TRANSPORT PROPERTIES. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 777-781. [illegible] refs. (May.) (Available in EPA-600/2-75-069, Oct. 1975.)

The continuum approach to particulate flow in the wake region behind a circular cylinder was utilized to identify and experimentally evaluate the appropriate transport properties. The criteria of a dilute suspension was applied, which allowed separation of the gaseous phase equation of mean motion from the particulate equation of mean motion. This type of unrestricted turbulent flow is also found in jets and wall boundary layers in the free state. Whereas the gaseous wake flow in the fully developed region could be characterized by a similar solution, the particulate flow could not, because of the nonlinearity of the gaseous-particulate transfer term. Neglect of this term in the governing equation of motion for particulate flow permitted a solution and analogous to the gaseous flow - Gauss function. Measurements within the particulate wake included particulate velocity and particulate density (mass con centerline) where the wake centerline defects persisted far downstream before fully developed conditions were established. Distributions of the particulate variables transverse to the wake became Gaussian at the downstream distance where the gaseous flow is fully developed. The experimental system consisted of a closed-loop air flow facility and the particulate material was composed of glass beads (count mean diameter equals 11 micron). Knowledge of the particulate transport properties, especially their relation to the gaseous transport properties, is useful in calculations applied to particulate control devices. (Author abstract)

60711

Kasahara, Mikio and Kenji Takahashi

EXPERIMENTAL STUDIES ON AEROSOL PARTICLE FORMATION BY SULFUR DIOXIDE. Atmos. Environ., vol. 10:475-486, 1976. 34 refs.

The formation and growth of aerosol particles of dilute sulfuric acid produced by photochemical oxidation of sulfur dioxide (0.03-10 ppm, by volume) in purified air has been studied quantitatively in laboratory apparatus. The number of particles formed is strongly dependent on SO2 concentration, relative humidity (less than 10-80%) and u.v. light intensity. The number concentration increases rapidly to a maximum within a few minutes after the start of irradiation and then decreases slowly during the next 10 min. Particle size increases with irradiation time and is dependent on SO2 concentration, and on relative humidity when the SO2 concentration is less than 0.1 ppm. In the conditions employed the volumetric rate of formation of particles ranged from 0.10 to 18.7 cu micrometers/cc/hr. The overall quantum yield of photochemical reaction was 0.006. The oxidation rate was 0.06%/hr; extrapolation of this rate to noonday sunlight in summer at latitude 35 deg N gives 0.7%/hr. (Author abstract)

60714

Stober, Werner

DESIGN, PERFORMANCE AND APPLICATIONS OF SPIRAL DUCT AEROSOL CENTRIFUGES. Fine Part. Symp. Proc., Minneapolis, Minn., 1975, p. 351-397. 66 refs. (May.) (Available in EPA-600/2-75-059, Oct. 1975.)

A review of the design, the performance and the applications of spiral duct aerosol centrifuges as they are increasingly used in aerosol particle size spectrometry and related aerosol research is given. Background, advantages and limitations of this type of instrument and its modifications are discussed. Precision measurements of dynamic shape factors on certain types of nonspherical particles as well as applications to high-resolution size distribution analysis are reported. Comparative studies of different authors on the possibility of using the spiral duct aerosol centrifuge as an absolute instrument for aerodynamic size distribution measurements are compiled from literature. Data on aerosol particle densities obtained with spiral duct centrifuges are reported and problems of measuring cigarette smoke and dense aerosols are discussed. An adaptation of a short spiral duct centrifuge for applications to ambient particulate air pollution is described and a recent feasibility study of developing the instrument into an aerosol mass distribution monitor by way of using piezoelectric quartz crystals as size-selective mass sensors is reported. (Author abstract)

60716

Middleton, Paulette, Glen K. Yue, and C. S. Kiang

KINETIC MODEL FOR SULFATE AEROSOL. Preprint, National Center for Atmospheric Research, Boulder, Colo., 15p., 1976. 7 refs. (To be presented at the International Air Pollution Symposium, 12th, Paris, France, May 7, 1976.)

A numerical model is constructed to simulate the gas-to-particle conversion and aerosol growth of sulfuric acid particles in smog chamber experiments and in the atmosphere. The model incorporates the mechanisms of heteromolecular nucleation, heteromolecular condensation and thermal coagulation. Various atmospheric and chamber conditions are used to simulate the evolution in time of the particle size distribution. It is shown that the evolution of the particle size distribution depends on the initial size distribution, the relative humidity and the rate of production of sulfuric acid gaseous molecules. (Author abstract)

60720

Yue, Glenn K., Volker A. Mohnen, and C. S. Kiang

SULFUR DIOXIDE TO SULFATE CONVERSION IN THE ATMOSPHERE. Preprint, Atmospheric Sciences Research Center, State University of New York, Albany and National Center for Atmospheric Research, Boulder, Colo., 14p., 1976. 11 refs. (Presented at the International Air Pollution Symposium, 12th, Paris, France, May 7, 1976.)

Two conversion processes for sulfur dioxide to sulfate are discussed: (1) gas phase oxidation via OH radical; (2) liquid phase oxidation in the presence of ammonia under various atmospheric conditions. The relative importance of these two processes under different environmental conditions is investigated. It is shown that the most important parameter for the production of sulfate in aerosol is the concentration of sulfuric acid gaseous molecules. The effects of temperature and droplet size on the relative importance of these two mechanisms have also been studied. (Author abstract)

K. STANDARDS AND CRITERIA

[illegible]

Lemke, Eric E., John R. Williamson, and Herbert Simon

THE EVOLUTION OF A COMPREHENSIVE SET OF PARTICULATE RULES. Preprint, Air Pollution Control Assn., Pittsburgh, Pa., 24p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-92.)

The Los Angeles County Air Pollution Control District utilizes three different but related control rules for the control of particulate emissions. First, highly visible effluent plumes such as smoke and submicron particulates are controlled by two rules which complement each other. A particulate matter control rule has been developed to restrict the concentration of particulate matter in the effluent in grains/standard cu ft of dry gas. This rule establishes a decreasing allowable grain loading with increasing effluent volume. The volume is calculated as dry gas at standard conditions. The other particulate matter control rule limits the mass emission rate in lb/hr. The mass emission rate rule requires an increase in collection efficiency as the weight of materials processed in a specific operation increases. (Author abstract)

63222

Curran, Thomas C. and William F. Hunt

INTERPRETATION OF AIR QUALITY DATA WITH RESPECT TO THE NATIONAL AMBIENT AIR QUALITY STANDARDS. Preprint, Air Pollution Control Assn., Pittsburgh, Pa., 14p., 1974. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-78.)

The problem of interpreting air quality data with respect to the National Ambient Air Quality Standards (NAAQS) is presented for those responsible for evaluating compliance with the NAAQS. A series of diverse topics that relate to frequent questions concerning the comparison of air quality data with the standards is explained. Basic conventions regarding significant features are indicated as well as more detailed discussions concerning the averaging times employed in comparing air quality data with particular standards. The distinction is made between two general categories of standards: annual mean standards and once-per-year standards. Conventions concerning the determination of compliance for both types of standards are discussed as well as statistical factors affecting inferences made in these evaluations. In particular, the influence of sampling frequency upon the results is examined. Recommendations are made concerning each major point and the relative merits of these suggestions are indicated. (Author abstract modified)

63241

Hovey, Harry H., Howard C. Jones, and William H. Stasiuk

DEVELOPMENT OF SHORT-TERM AIR QUALITY STANDARDS FOR SUSPENDED PARTICULATE MATTER IN NEW YORK STATE. Preprint, Air Pollution Control Assn., Pittsburgh, Pa., 32p., 1974. 9 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-283.)

The development of short-term air quality standards for suspended particulate matter in New York State is described. The Clean Air Act of 1970 requires each state to submit plans for implementation, maintenance, and enforcement of National Ambient Air Quality Standards subsequent to promulgation. Air quality standards for averaging times shorter than 1 yr are needed to shorten the time required to show contravention and to provide a basis for early corrective measures to regulate specific sources. Daily suspended particulate data was analyzed by the Kolmogorov-Smirnov goodness of fit technique to determine that the form of the distribution was log normal. A method developed by Larsen for predicting short-term maximum concentrations of log normally distributed data was used to determine numerical values for 1, 3, and 6-month standards. A graphical approach was also used with equivalent results. Monthly, bi-monthly, and tri-monthly suspended particulate standards of 135 micrograms/cu m, 115 micrograms/cu m, and 100 micrograms/cu m, respectively are proposed for the most extensively developed areas of New York State and correspondingly lower values for other areas. The methods are generally applicable to other air contaminants. (Author abstract modified)

67029

Office of Air and Waste Management, Research Triangle Park, N. C., Office of Air Quality Planning and Standards

BACKGROUND INFORMATION ON NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS: PROPOSED AMENDMENTS TO STANDARDS FOR ASBESTOS AND MERCURY. (FINAL REPORT). Rept. EPA-450/2-74-009a, 149p., Oct. 1974. 21 refs. (NTIS: PB 239 030/AS)

The rationale for proposed amendments to the national emission standards for asbestos and mercury that were promulgated April 6, 1973 is presented along with the economic and environmental impacts of such amendments. Summaries of proposed amendments concerning asbestos are given for operations involving manufacturing (shotgun shell manufacture and asphalt concrete plants), demolition and renovation, fabrication, and asbestos waste disposal. A proposed amendment relating to mercury emissions from sludge incineration and drying facilities is also summarized. The proposed amendments to the asbestos and mercury standards will have significant beneficial effects by reducing emissions to the outside air, although they may also have limited adverse effects on land and water resources. The use of dust suppression agents to prevent wind erosion of asbestos waste may cause water pollution, and alternative disposal methods to the incineration of wastewater treatment plant sludges may cause mercury pollution of land and water. Estimated economic impacts are outlined for each type of affected facility.

67126

Office of Air and Waste Management, Research Triangle Park, N. C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: ELECTRIC SUBMERGED ARC FURNACES FOR PRODUCTION OF FERROALLOYS. VOLUME 1:

PROPOSED STANDARDS (FINAL REPORT). Rept. EPA-450/2-74-018a, 163p., Oct. 1974. 143 refs. NTIS: PB 237612/AS

Background information for proposed standards of performance for electric submerged arc furnaces in the ferroalloy industry are presented in connection with formal proposals appearing in the Federal Register. Topics covered include: processes and emissions from the ferroalloy industry; proposed mass standards and opacity standards; emission control technology involving open furnaces, semi-enclosed furnaces, sealed furnaces, and control of fumes during tapping; environmental effects in relation to air, water, solid waste pollution, and energy considerations; procedures for developing standards; data for substantiating standards; economic information, including control costs and economic impact; alternative standards for particulate matter, carbon monoxide, and visible emissions; and enforcement aspects of proposed standards, including emission monitoring. Data are given for estimated ground level particulate concentrations caused by submerged arc ferroalloy furnaces at various downwind distances as well as for emission rate comparisons between controlled and uncontrolled furnaces.

69115

Office of Air and Waste Management, Research Triangle Park, N.C., Emission Standards and Engineering Div.

BACKGROUND INFORMATION FOR STANDARDS OF PERFORMANCE: COAL PREPARATION PLANTS. VOLUME 1: PROPOSED STANDARDS (FINAL REPORT). Rept. EPA 450/2-74-021a, 58p., Oct. 1974. 7 refs. NTIS: PB 237422/AS

Proposed standards of performance for coal preparation plants (both wet cleaning and dry cleaning systems) are presented. The proposed standards limit emissions of particulates (including visible emissions) from the following sources: thermal dryers, pneumatic coal-cleaning equipment (air tables), coal processing and conveying equipment (including breakers and crushers), screening equipment, coal storage, coal transfer points, and coal loading facilities. The standards apply at the point(s) where undiluted gases are discharged from the air pollution control system or from the affected facility if no air pollution control system is utilized. Particulate matter from thermal dryers would be limited to no more than 0.070 gr/dry standard cu m and less than 20% opacity, while particulates from pneumatic coal-cleaning equipment would be limited to no more than 0.040 gr/dry standard cu m and less than 10% opacity. Particulate matter from other affected facilities would be limited to less than 20% opacity. Background information on the following topics is also provided: process description, emissions and methods of control, existing air pollution standards, the rationale for proposed standards, and the environmental and economic impacts of the proposed standards.

73811

Dept. of Commerce, Washington, D.C., Environmental Affairs Div.

IMPLICATIONS OF AIR NON-DEGRADATION POLICIES ON CLEAN AIR REGIONS: A CASE STUDY OF THE DALLAS-FORT WORTH AQCR (215). 60p., May 1974. 3 refs. NTIS: COM-74-11240

Baseline and potential air pollution (sulfur dioxide and particulates) from industrial and area source emissions in the Dallas-Fort Worth Air Quality Control Region are examined in terms of projected growth patterns and proposed alternative nondegradation air quality criteria. Baseline 1972 SO2 concentrations in the area are well below the 60 microgram/cu m annual secondary standard, with the largest concentration being 10 microgram/cu m. Calculated annual particulate averages (1-9 microgram/cu m) are much lower than measured values (25-100 microgram/cu m) due to natural background dust in this area. Area sources contribute nearly 80% of the total emitted particulates and SO2 emissions, and control of these sources is essential to maintaining or improving air quality. Annual average SO2 concentrations are projected to increase by about 8 microgram/cu m by 1990, assuming present fuel use patterns and the best available control technology. Within this two decade time frame, the proposed SO2 increment of 15 microgram/cu m is not expected to be reached; hence, growth of the population or industry will not be limited. Unless natural background contributions of particulates are excluded from calculations, the ambient air concentration limits of Environmental Protection Agency or Sierra Club plans preclude appreciable growth in the area. (Author summary modified)

77007

Pace, Thompson G., III and Walter H. Stevenson

THE NATIONAL STATUS OF AIR POLLUTION BY TOTAL SUSPENDED PARTICULATES AND FUTURE PROSPECTS FOR CONTROL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1975. 10 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-28.1.)

An overview of the attainment status of the National Ambient Air Quality Standards for particulate matter is presented. Major problems related to the attainment of particulate standards include conventional stationary and mobile sources, high urban background concentrations, and rural fugitive dust problems. The urban background problems are being experienced in many areas of the United States and are associated with particulate emissions from tire and pavement wear, windblown dust, street dust caused by traffic flow, and construction activities. The rural problems are associated with farm land dust and unpaved roads and generally occur in the arid southwestern states. As conventional stationary sources continue to reduce particulate emissions, it may be necessary for future control efforts to be redirected toward fugitive dust sources. (Author abstract modified)

83784

Walsh, George W.

EMISSION STANDARDS FOR PARTICULATES. J. Air Pollution Control Assoc., 25(2):101-102, Feb. 1975.

New Source Performance Standards for stationary sources are discussed in relation to the problem of fine particulate control. Although performance standards tend to accomplish the goal of fine particulate control indirectly by being written stringent enough for total particulate control, there is nevertheless a limit beyond which such standards cannot go without a formal regulatory effort to control fine particulates. The establishment of such a regulatory problem requires that the present ability to predict collector performance be significantly improved.

L. LEGAL AND ADMINISTRATIVE

11849

Reilly, William, Clemens A. Lacombe, and Fredrick Voigt

PHILADELPHIA'S EXPERIENCE IN THE CONTROL OF EMISSIONS FROM ASBESTOS SPRAY FIREPROOFING OPERATIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1971. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th Atlantic City, N. J., June 27-July 2, 1971, Paper 71-53.)

The multiple environmental health problems associated with the use of asbestos spray fireproofing and the administrative and legal steps taken by Philadelphia to control this problem are described. Medical studies documented a correlation between exposure to asbestos and mesothelioma. With this evidence, medical experts recommended zero emission from the use of asbestos as fireproofing for structural steel members in construction work. The Air Management Services worked with the construction industry in attempts to control the emissions from the spraying and related construction operations. This included the use of several types (fibrous and cementitious forms) of asbestos spray material and detailed procedures for the spraying operations covering methods for enclosures, mixing, clean up, disposal, and worker protection. It was also announced that no permits would be issued for the spraying of asbestos unless it could be demonstrated that it could be fully controlled. Another parallel and difficult problem is the demolition of buildings which contain appreciable quantities of asbestos construction or insulating materials. In these cases, control should be 100% containment of visible emissions. New demolition procedures must be developed to achieve this result. (Author abstract modified)

11474

Wilson, Edward F. and William Reilly

ENFORCEMENT PROCEDURES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1971. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-8.)

In the Fall of 1969, Philadelphia adopted an Air Management Code, a broad-based enabling act with an expanded set of definitions giving broad administrative and enforcement powers to the Department of Health, Licenses and Inspections, and Law and extensive regulatory authority to the Air Pollution Control Board. The philosophy of the enforcement procedure is to obtain compliance with the standards of the Air Management Code and Regulations through the development and implementation of improvement programs. If this approach is not successful, the full line of enforcement actions can be brought to bear, including municipal court action and fines, orders, license revocation, sealing of equipment, and common pleas court action in the form of an injunction or restraining order. Air Management Services initiates enforcement actions only when it is determined that other types of administrative remedies will not accomplish the job. In all cases where it is appropriate, industrial and commercial companies with responsive management are given ample opportunity to develop improvement programs. Because of the flexibility provided by the Air Management Code and the fact that the Enforcement Procedures are designed to maintain and utilize this flexibility, Air Management Services has the capability to choose the course of action which will give the maximum result with minimum dislocation and resource requirement. (Author abstract modified)

17348

Lawyer, B. E. and C. G. Beard, II

WEST VIRGINIA'S NEW CONCEPT IN REGULATING PARTICULATE MATTER FROM MANUFACTURING PROCESSES. J. Air Pollution Control Assoc., 22(2): 96-99, Feb. 1972. (Presented at the Air Pollution Control Association Meeting, Annual, 64th, Atlantic City, N. J., Paper 71-38.)

The regulation (Regulation VII) limiting the emission of solid and liquid particulate matter from manufacturing processes in West Virginia is based on a modified process weight standard. The modification is manifested in a duplicate source concept with several allowable emission rate curves for different industrial categories rather than the conventional unit approach with a single curve. Any combination of like units within a plant is defined as a duplicate source, and the combined process weight of all units comprising a duplicate source is used to enter the process weight table for determination of the total allowable emission from all such units. The allowable emission rate from each individual unit is then determined by prorating the total emission by the appropriate process weight ratios. To avoid undue restrictions on industrial growth, the regulation includes an expansion formula for determining the emission rate for a new addition to a controlled existing plant. The duplicate source concept is expected to minimize the economic inequity between competing industries with regard to air pollution control.

44801

Potts, Kenneth N. and David W. Jones

TEXAS' EXPERIENCE IN INTEGRATING LOCAL, REGIONAL AND STATE PROGRAMS FOR EFFECTIVE AIR POLLUTION CONTROL ACTIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 14p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-41.)

The necessity of planning for effective air pollution control is emphasized, and the unique characteristics of air pollution control and management problems in Texas are described. The experiences of the Texas Air Pollution Control Services in integrating local, regional, and state programs are related. As a solution to problems, an implementation planning office responsible for development, coordination, and collation of the plan was established. Local programs were analyzed through the use of planning conferences to define critical areas of interfacing and reach a final agreement of the primary of functions. This initial contact started activities in the right direction and ultimately a comprehensive chart was produced formalizing salient functional areas. The staffing of the 12 Air Quality Control Regions played a major role in providing satisfactory interfacing between the different levels of management and control. This coupled with the establishment of a source surveillance system, provided local and regional control officials with data concerning the enforcement activities and the central office with planning, management, and supervisory data. Interstate cooperation was formalized through planning conferences involving New Mexico, Oklahoma, Arkansas, and Louisiana. International cooperation is presently on an ad hoc basis, but the coordination between technical personnel at the working level on both sides of the border is accelerating. Thus the local, regional, and State programs were integrated effectively by the Texas Air Control Program. (Author abstract modified)

41061

Blair, Roger

KENTUCKY'S AIR POLLUTION CONTROL EXPERIENCE WITH THE ROAD PAVING INDUSTRY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1972. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-86.)

Kentucky's experience with the road paving industry and methods devised to implement air pollution control regulations, are presented. The first step was a seminar which presented an accurate picture of air pollution control laws and regulations are they applied to an asphalt batch plant with special emphasis on the permit regulation and the particulate emissions regulation for process operations. It outlined enforcement activities and emphasized what the owner could expect in terms of inspections and legal activities as a result of those inspections. The internal procedures followed in evaluating various types of applications and guidelines for the plants to follow towards compliance with the regulations were given. As many as 50% plants and about 90% of the asphalt concrete production plants were represented at the seminar. By following the guidelines for both quarries and asphalt plants, plants can devise a control system for compliance, and an agency can standardize its evaluations procedures. The guidelines considered the following aspects: haul roads, stockpiles, settling ponds, control equipment, fugitive dust sources, drilling and blasting sites, and evaluation techniques. The total program emphasized more effective control equipment. As a consequence, venturi scrubbers and a number of baghouses were installed. Since March 27, 1972, was established as the deadline for compliance with the emission limitations for process operations, it was proposed to issue cease and desist orders to individuals who have not filed a permit to operate to issue notices of charges against any individual operating without a permit or having emissions in excess of those stipulated, and to notify the Commissioner of Highways of those firms in violation of the regulations and request that no contracts be accepted with them. As result of this approach, more than 75% of the plants currently in operation have complied, or are in the process of complying with regulations. Although the approach concerns two specific industries, the basic principles are applicable to other industries as well. This type of seminar and industry-wide approach are highly beneficial to industries and air pollution control agencies faced with similar problems. (Author conclusions modified)

51491

Hemeon, Wesley C. L.

A CRITICAL REVIEW OF REGULATIONS FOR THE CONTROL OF PARTICULATE EMISSIONS. J. Air Pollution Control Assoc., 23(5):376-387, May 1973. 68 refs.

Regulations for the control of particulate emissions are critically reviewed. The design of present emission standards began with the Los Angeles rules of 1949 based on a survey of industries in the region and on engineering consideration of what was feasible for those industries to comply with, in terms of commercially available gas cleaning equipment. The Clean Air Act of 1967 was based on another California Act which required the development of an ambient air quality standard and the measurement of existing concentrations of pollutants. This system was unworkable because it required states to develop emission regulations either by measurement of air quality or by data on existing emissions or both. The 1970 Amendments to the Clean Air Act require states to establish and operate appropriate devices, methods, systems and procedures necessary to monitor, compile, and analyze data on ambient quality. The number of samples and sampling stations are among the provisions not specified. There is no evidence that health is impaired by air pollutants, yet the 1970 Amendments provide that primary ambient air quality standards are those requisite to protect the public health; secondary standards are to protect the public against sensory air pollution offenses. The methods advocated by the Environmental Protection Agency for measurement of particulate matter in ambient air are an integral part of air pollution regulations. The EPA does not recognize the sampling techniques of the American Society of Testing Materials and the American Society of Mechanical Engineers although their techniques produce the same results as the modified EPA train that the EPA specifies be used.

59578

Pooler, Francis, Jr.

NETWORK REQUIREMENTS FOR THE ST. LOUIS REGIONAL AIR POLLUTION STUDY. J. Air Pollution Control Assoc., 24(3):228-231, March 1974. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 1973, Paper 73-168.)

Criteria determining siting requirements for a monitoring network are briefly reviewed, together with the modelling and other objectives of the Regional Air Pollution Study. The schematic layout of sites proposed for St. Louis is described and discussed in terms of the conflicting requirements of extended regional coverage vs. close spacing of sites to achieve desired spatial resolution. More detailed criteria for selection of specific sampling locations within the general network layout are described. These depend on both physical features in the immediate vicinity of proposed locations, and on the locations of both near and distant sources. There were 25 sites selected which will measure carbon monoxide, hydrocarbons, nitrogen oxides, sulfur dioxide, fine particulates, and such meteorological parameters as wind, temperature, moisture, turbulence, and solar and sky radiation. (Author abstract modified)

61309

Kennedy, A. S., K. G. Croke, T. E. Baldwin, and R. L. Reisenweber

AIR POLLUTION/LAND USE PLANNING PROJECT VOLUME I. SELECTED LAND USE CONTROL POLICIES FOR AIR QUALITY MANAGEMENT. Argonne National Lab., Argonne, Ill., Center for Environmental Studies, Office of Air and Water Programs, Interagency Agreement Environmental Protection Agency EPA-IAG-0118(D), Rept. EPA-450/3-74-020-a, 86p., May 1973.

Alternative means for the control of high emission source clustering were investigated in order to meet and maintain ambient air quality standards called for by the Clean Air Act of 1970, specifically, nondegradation of air quality presently better than the national standards. Three policies were considered: air pollution impact statements; zoning control in two forms, permitted use zoning and emission density limited zoning; and the prediction of air pollution impacts of comprehensive regional land use plans. The source clustering problem in the Chicago area was studied specifically in relation to the effectiveness of the three investigated control strategies. An impact statement policy can be based on the two digit SIC classification. Emission density zoning is an effective long range control and is no more costly than point source control, assuming a viable zoning process. Deterioration in air quality is predictable and controlled virtually by the definition of the density limitation. Comprehensive planning as a control mechanism depends on the stability of the plan over time; the ability of public administrators to implement the plan; and the ability of planners to forecast the air quality effects of land use decisions and policies and to rank land use. (Author abstract modified)

65301

Hougland, Erik S. and N. Thomas Stephens

AIR POLLUTANT MONITOR SITING BY ANALYTICAL TECHNIQUES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1974. 3 refs. (Presented at the Air Pollution Control Association Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-49.)

A source oriented monitor site location model providing monitor site assignments designed to maximize monitor coverage of a region within existing equipment limitations is presented. It gives priority to areas with high emission levels and high concentrations without neglecting weaker sources. The method is easy to use and inexpensive in computer resources. It is limited by the necessity to use a discrete set of potential sites. A model which can choose from the continuous set of points of a map is required. The sensitivity of the model to input parameters such as the number of wind directions and the spacing of potential monitor sites needs to be examined in detail. Refinements in the calculation of coverage factors needs to be made. Work on these items is currently in progress. Results of an example problem are presented and compared with a monitoring network already in place. (Author summary modified)

65327

Faith, W. L.

AN EVALUATION OF FUGITIVE DUST REGULATIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 10p., 1974. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., June 9-13, 1974, Paper 74-88.)

The nature of fugitive dust regulations in the various states, many of which are based at least to some degree on the Federal example regulation in Appendix B of 40 CFR Part 51, is discussed. The Federal example calls for reasonable precautions to be taken to control fugitive dust and cites suitable control procedures for various sources. Many states have adopted these regulations in whole or in part. Many have made the regulation more definitive by requiring that emissions beyond the property line of the source be invisible or meet a specific opacity limitation, particle size, or number limitation, or not exceed the ambient air quality standard for particulate matter. The attempt to make the regulation more definite often has created more problems than it has solved. Inasmuch as fugitive dust problems are highly localized, it is likely that across-the-board regulations may not be suitable. Specific regulations should be written for those sources of greatest importance in a given state. If across-the-board regulations are desired, the Federal example regulation without added numerical limitations is the best approach.

67038

Gerstle, Richard W. and Donald J. Henz

ADMINISTRATIVE AND TECHNICAL ASPECTS OF SOURCE SAMPLING FOR PARTICULATES (FINAL REPORT). PEDCo-Environmental Specialists, Inc., Cincinnati, Ohio, Office of Air and Waste Management Contract CPA 70-124, Rept. EPA-450/3-74-047, 89p., Aug. 1974. 10 refs. NTIS: PB [illegible]

The technical and administrative aspects of establishing a source-sampling program for particulates within an air pollution control agency are presented. Topics considered include: functions of the source sampling unit, regulations required to conduct source sampling, legal use of source-sampling information, the organization and administration of a source sampling unit, preliminary procedures required for conducting a stack test, measurement of stack gas velocity and related parameters, determination of isokinetic sampling rates, minimal sampling conditions, particulate sampling equipment, sampling procedures, disassembly and particulate clean-out procedures, particulate analysis, test report format and presentation of results, and the significance of errors in source sampling. Appendices are provided to illustrate nomographs for use with sampling trains, the cleaning of train components, and orifice calibration procedures.

[illegible]

Hobson, Richard M. and [illegible]

EVALUATING THE IMPACT OF NEW INDUSTRY ON A CITY'S PARTICULATE LEVELS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 19p., 1974. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 67th, Denver, Colo., 1974.)

An urban diffusion model known as the Air Quality Display Model (AQDM) was used to determine the impact of locating new industry in two industrial parks on particulate dispersion in the Huntsville, Alabama area. Source area, meteorological data, and receptor data were used as input, and the primary output of the model was the computed ground level concentration at each of the grid and non-grid receptors. The model was run with a number of increase emission estimates at each of the two industrial parks to study the impact of new industry on particulate concentrations. Stack heights were assumed to be zero; therefore, the emissions were not dispersed over a wide area. The maximum particulate emissions from both parks acceptable in terms of not exceeding the annual Federal standard of 75 micrograms/cu m were estimated at a total of 40 tons. The maximum 24-hour concentration necessary for emissions to reach 40 tons from both parks was estimated to be 180 micrograms/cu m. Subsequent programming modifications incorporated into the model included the addition of wind rose data for two major metropolitan areas in the state and the addition of an optional method of computing the plume rise using the Briggs equation.

70049

[illegible], R. J.

A NATIONAL AIR POLLUTION SURVEILLANCE NETWORK DESIGN. Preprint, North Atlantic Treaty Organization Committee on the Challenges of Modern Society, Expert Panel on Air Pollution Modeling, 15p., 1974. 3 refs. (Presented at the Expert Panel on Air Pollution Modeling, 5th Meeting, Roskilde, Denmark, June 4-6, 1974.)

The application of dispersion modeling to the design of an air pollution surveillance network is discussed. The design of an air pollution surveillance network is possible with the aid of two complementary tools: the emission inventory and the dispersion model. Simple climatological models are capable of providing reliable information for the design of networks and can operate within the constraints of such a network, providing the pollutants under consideration are limited to sulfur dioxide and particulates. Implementation of such models for these pollutants is recommended. Research on the development of similar simple models for the dispersion of automotive and photochemical pollutants is also suggested. The stages in the design of an air pollution surveillance network are: the identification of areas in need of surveillance; identification of the pollutants present and the type and number of monitors necessary; the determination of general locations for monitoring stations, followed by the determination of actual monitoring locations according to physical constraints; the selection and design of actual equipment installations; the establishment of operating and maintenance procedures; the establishment of data collection, handling, and reporting procedures; and the evaluation of overall network design after a reasonable trial period, with the implementation of appropriate revisions.

75507

Abcor, Inc., Cambridge, Mass., Walden Research Div.

MODELING ANALYSIS OF POWER PLANTS FOR EVALUATION OF IMPACT OF AMBIENT SO2 CONCENTRATIONS MIDLAND-ODESSA-SAN ANGELO AQCR 218. Office of Air and Waste Management Contract, 56p., March 1975, 3 refs.

Diffusion modeling analyses of sulfur dioxide emissions from five thermal power plants located in the Midland-Odessa-San Angelo Air Quality Control Region (Texas) are presented as part of an effort to determine the air quality impact of such operations in the face of possible changes in fuel use and compliance schedule extensions. Emissions under both nominal and maximum loads from each of the five plants result in contributions to ambient air concentrations which by themselves do not exceed the primary 24-hour and annual SO2 air quality standards. The ratio of the ambient SO2 concentration to the emission rate for a given plant in micrograms/cu m per g/sec ranges from 0.40-3.1 and 0.31-1.6 for nominal and maximum loads, respectively, on maximum concentration days and from [illegible] for the maximum annual concentration. These values indicate the relative pollution potential for each plant which is primarily a function of stack design as well as surrounding terrain features.

75521

GEOMET, Inc., Gaithersburg, Md.

MODELING OF THE IMPACT OF POWER PLANTS ON AMBIENT SO2 CONCENTRATIONS IN NORTHEAST ARKANSAS AQCR 17 (FINAL REPORT). Office of Air and Waste Management Contract 68-02-1483, Rept. 136, 33p., Dec. 1974, 6 refs.

Diffusion modeling analyses of sulfur dioxide emissions from three thermal power plants located in the Northeast Arkansas Air Quality Control Region are presented as part of an effort to determine the air quality impact of changes in fuel use and state implementation plans in the face of limited fuel availability. Emissions under either nominal or maximum load conditions at each plant produce contributions to ambient SO2 concentrations which do not exceed the Federal 24-hour air quality standard. Emissions from each plant under nominal load conditions do not result in the annual average standard being exceeded. The values of the ratio of the ambient SO2 concentration to the emission rate of a given plant, in micrograms/cu m per g/sec, ranged from 0.1-0.77 and 0.10-0.98 for nominal and maximum loads, respectively, on maximum concentration days and from 0.0004-0.003 for the maximum annual average concentration. These values indicate the relative pollution potential of each plant. (Author conclusions modified)

75576

GEOMET, Inc., Gaithersburg, Md.

MODELING OF THE IMPACT OF POWER PLANTS ON AMBIENT SO2 CONCENTRATIONS IN LAKE MICHIGAN AQCR 237. Office of Air and Waste Management Contract 68-02-1483, Rept. EF-386, 31p., Nov. 1974, 6 refs.

Diffusion modeling analyses of sulfur dioxide emissions from the J. P. Pulliam and Edgewater thermal power plants located in the Lake Michigan Air Quality Control Region (Wisconsin) are presented as part of an effort to determine the air quality impact of such operations in the face of possible changes in fuel use and compliance schedule extensions. Sulfur dioxide levels resulting from emissions from each plant under nominal load conditions do not exceed the 24-hour or maximum annual air quality standards. Emissions under maximum load conditions at the J. P. Pulliam plant result in contributions to ambient air concentrations which by themselves exceed the 24-hour standard, while those from the Edgewater plant do not cause the 24-hour standard to be exceeded. The values for the ratio of the ambient SO2 concentration to the emission rate of the plants in micrograms/cu m per g/sec are 0.24 and 0.08 under nominal load and 0.23 and 0.10 under maximum load for the Pulliam and Edgewater plants, respectively, on maximum concentration days. The values for the maximum annual concentration are 0.013 and 0.050 for the Pulliam and Edgewater plants respectively. These values indicate the relative pollution potential of the plants.

75684

Dozier, Jay F., Roger B. Rinder, and Phillip A. Roberts

THE AIR QUALITY AND ENERGY IMPLICATIONS OF SUPPLEMENTARY CONTROL SYSTEM IMPLEMENTATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1975, 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-29.1.)

The implementation of supplementary control systems as an interim measure for attaining air quality standards in the near term until sufficient stack gas scrubbing devices are available for sulfur dioxide control is discussed with particular reference to the electrical power production industry in Illinois. A supplementary control system is a program that incorporates real-time monitoring of stack emissions, meteorological conditions, and air quality with a numerical scheme for determining current and future ambient air quality in the vicinity of a specific source. Thus, when selected levels of ambient air quality are obtained or forecasted, specific emission reduction activities can be undertaken. The use of supplementary control systems for the primary power plant candidates would account for approximately one fourth of the 1973 Illinois coal production and half of the coal which remains in the state. Without the supplementary controls, this quantity of coal would be displaced by low-sulfur western coals, resulting in a severe economic impact on the Illinois coal industry. Furthermore, the added cost to the utilities would approach $80 million/yr. (Author abstract modified)

71998

Rubin, Edward S. and Harold I. Bloom

MAINTENANCE OF AMBIENT PARTICULATE STANDARDS IN AN INDUSTRIALIZED REGION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 1975. 18 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-06.1.)

Modeling studies and air quality data analysis are applied to the region of Allegheny County, Pennsylvania to assess the adequacy of existing regulatory policy for attaining secondary air quality standards in the next decade, during which time little regional growth is expected. Under compliance with existing emission regulations, currently inventoried sources are projected to contribute about one third of the annual future impacts of fugitive emissions, especially from industrial process operations, and of background concentrations advected into the region. Present estimates of the latter impact indicate values of about 45 to 50 micrograms/cu m, which are about 50% higher than values heretofore assumed for Allegheny County. It also appears that attainment of short-term standards may impose the more stringent control requirements, though definitive assessments of control needs are hampered by inadequacies in modeling techniques, source inventories, and ambient monitoring data. Efforts to upgrade these areas in the context of intensive local studies are seen as the most immediate need for meaningful air quality maintenance projections in industrialized regions such as Pittsburgh. (Author abstract)

77001

Keeling, Billy T., Robert J. Schreiber, Jr., and James H. Long

MISSOURI'S WORKABLE FUGITIVE DUST REGULATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 10p., 1975. (Presented at the Air Pollution Control Association, Annual Meeting, 68th, Boston, Mass., June 15-20, 1975, Paper 75-38.3.)

The development and implementation of Missouri's fugitive dust regulation is described, with particular emphasis on its effectiveness in controlling emissions from industries which do not readily lend themselves to process weight regulations. The versatility and ease of application of the regulation is dependent on the use of the microscope to clearly identify the nature and source of the material creating the nuisance. Specific examples of successful application of the regulation are cited for rock quarrying operations, the wood products industry, cotton gins, large grain elevators, and an iron pelletizing operation. (Author abstract modified)

78130

Lillis, Edward J. and Jean J. Schueneman

CONTINUOUS EMISSION MONITORING: OBJECTIVES AND REQUIREMENTS. J. Air Pollution Control Assoc., 25(8):806-809, Aug. 1975. 2 refs.

The benefits of the continuous emission monitoring regulations proposed by the Environmental Protection Agency are described. The regulations require existing and new sources within certain specified source categories to install, operate, and maintain continuous emission monitoring systems. Continuous emission monitoring provides a full time data base for both the control agency and the source operator. The systems permit control agencies to evaluate nuisance conditions, to develop a more comprehensive air resource management plan for the community, to determine the specific emissions of each major source within the community, and to develop more accurate relationships between ambient ground level concentrations and emission rates. The systems provide process operators with a tool to assist them in controlling plant operating conditions so as to achieve minimum emissions, improve operating efficiency, and to reduce costs.

84727

Johnson, Gary L., Maurice P. Schrag, and A. K. Rao

THE FINE PARTICLE EMISSIONS INFORMATION SYSTEM: A NEW PUBLIC DATA BANK. J. Air Pollution Control Assoc., 26(7):643-646, July 1976.

The Fine Particle Emissions Information System (FPEIS) is a computerized follow-on of the Fine Particle Emissions Inventory developed by Midwest Research Institute in 1971 as part of the Particulate Systems Study. A plan to update the 1971 inventory was initiated in July 1974 by the Industrial Environmental Research Laboratory (IERL) at Research Triangle Park, N. C. By early 1975, the planned update of the Fine Particle Emissions Inventory was supplanted by the concept of a computerized information system on fine particle emissions from stationary sources. The Fine Particle Emissions Information System is designed to contain source test data including particle size distributions; chemical, physical, and bioassay testing results performed on particulate samples; design and performance data on particle control systems applied; process descriptions of the sources; and descriptions of the sampling equipment and techniques employed. (Author abstract)

84745

Offen, G. R., J. P. Kesselring, K. Lee, G. Poe, and K. J. Wolfe

CONTROL OF PARTICULATE MATTER FROM OIL BURNERS AND BOILERS. Acurex Corp., Mountain View, Calif., Aerotherm Div., Environmental Protection Agency Contract 68-02-1318, Rept. EPA-450/3-76-005, 200p., April 1976.

The control of particulate emissions from oil-fired boilers that are used to generate hot water or steam and furnaces that are used to provide warm air for space heating is discussed. The emphasis is on control strategies that can be used by local or state air pollution control authorities to implement programs for the attainment or maintenance of national air quality standards in major urban centers. Building codes, regulations, combustion additives, fuel composition controls, maintenance and inspection procedures, emission limits, and many other pertinent topics are discussed for several categories of stationary sources.

84753

Bradway, Robert M., Gordon L. Deane, Rebecca C. Galkiewicz, David A. Lynn, and Frank A. Record

NATIONAL ASSESSMENT OF THE URBAN PARTICULATE PROBLEM (FINAL REPORT). GCA Corp., Bedford, Mass., GCA/Technology Div., Environmental Protection Agency Contract 68-02-1376, Task Order 18, Rept. GCA-TR-76-25-G(1), Rept. EPA-450/3-76-024, 200p., July 1976.

A study of the total suspended particulates in 12 U. S. cities is presented. The effect of various meteorological factors on TSP concentrations was studied, with emphasis on the ability of different regions to meet national air quality standards. The study identified 3 factors that affect attainment and maintenance of the TSP ambient standards: 3 general categories of sources that contribute to the TSP loadings at a given point (traditional sources such as fuel combustion and waste disposal; nontraditional sources such as particulates from auto exhaust and fugitive dust from construction; and natural and transported particulates), and 3 factors that act to modify the ambient levels measured (meteorology; and the monitoring network configuration and siting). These factors are discussed in detail. The general conclusions include the recognition that the regional-scale burden of transported and secondary particulates, especially sulfates, must be reduced; and the judgment that a broadly supported control effort directed at urban reentrained dust and similar non-traditional (not previously controlled) sources will be required in order to meet the present particulate standard.

N. GENERAL

44731

Lee, Wilbert L. and Arthur C. Stern

THE STACK HEIGHT REQUIREMENTS IMPLICIT IN THE FEDERAL STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 16p., 1972, 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-69.)

The promulgation of Federal standards of performance for certain classes of new stationary sources requires that such sources have minimum stack heights to meet the requirements of national air quality standards. The determination of minimum stack height is complicated by the facts that the performance and air quality standards are stated on different averaging time bases; that the extent of preemption of the assimilative capacity of the air by any individual source will vary among jurisdictions and, in some cases, among different geographic areas of a single jurisdiction; and that some new sources will be designed to emit appreciably less than the performance standard requirement. However, these complications can be resolved and equations and charts have been prepared from which minimum stack height can be selected. (Author abstract modified)

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